ANNUAL FORECAST VERIFICATION STATISTICS

1995

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Introduction

This collection of tables and figures contains series of statistics compiled from the results of routine verification over many years. Some of the statistics have been obtained by verifying the products of the numerical weather prediction model in operational use at the time: others have come from the verification of forecasts made by the staff of the Central Forecast Office and the outstations.

A brief summary of the NWP models used operationally in the Met Office is given below:

Nov. 1965-Jul. 1972	3-level Model	
Aug. 1972-Aug. 1982	10-level Model ('Octagon'	and 'Rectangle')
Sep. 1982-May 1991	15-level Model ('Coarse-Mesh'	and 'Fine-Mesh')
June 1991-	Unified Model ('Global'	and 'Limited Area')
Dec. 1992-	Unified Model ('Mesoscale')	

The following areas have been used for verification:

Northern Hemisphere	90°N - 30°N
Tropics	30°N - 30°S
Southern Hemisphere	30°S - 90°S
Area 2	W.Canada to Europe (See Figure 1)
48-points	U.K. (see Figure 2)

The Tables

Results from verification involving only computer-generated forecasts are presented in Tables 1 to 9. In Table 10 the hand-drawn analyses in CFO have been used to verify both machine and man-made forecasts. Tables 11 and 12 give results of subjective verification schemes. Verification results from the wave prediction models are presented in Tables 13 and 14.

Throughout the tables results are given in units of metres (heights and wave heights), hPa (pmsl), knots (winds) and seconds (wave periods). Persistence errors are preceded by a solidus "/". The use of asterisks indicates missing data. The terms 'Global' and 'Limited Area' are used generically to indicate the resolution of the model in use at the time.

The verification statistics presented in Table 1 have been derived using the best available observations, either radiosondes for the upper-air or synops and ships for the surface, while those in Tables 2 to 5 are based on comparisons with model analyses.

Table 6 presents verification of precipitation forecasts from the Limited Area Model against selected reporting stations in the UK and Europe for the past year. Table 7 gives verification scores calculated from these results for 1994 and for the preceding five years.

Table 8 presents verification of precipitation forecasts from the Mesoscale Model for the past year. The selection of UK reporting stations used is the same as that used in Table 6(a). Table 9 gives verification scores calculated from these results for 1994 and for 1993 and other verification statistics derived using surface observations.

Table 10 presents verification of CFO and model forecasts for the 6x8 array of points shown in Figure 2. This array is a legacy from the original grid of the 3-level model (see, for example, Meteorological Office Scientific Paper No 9) and the verification of the CFO forecast by this scheme (Table 10(a)) provides the longest run of verification statistics, back to 1957. Heights at 1000hPa and the implied geostrophic winds are verified against values extracted from the hand-drawn analyses in CFO.

Table 11 summarizes the performance of CFO's forecast of whether measurable precipitation will fall in London the next day. Model results since 1984 are also presented.

Table 12 presents results from verification of the forecasts for the whole UK on BBC Radio at 0755 and 1755. The forecasts are verified at Met Office outstations. Prior to 1991, annual results were calculated for the 12-month period from August to July.

Tables 13 and 14 present results from verification of the Global and European Wave Models respectively. The results given are averages over all observing stations. Wave height and wave period statistics are given. Forecasts of wind speed from the NWP models are used to drive the wave models, and so verification of wind speed is also given.

A summary of the tables is given below:

Table 1	GM verification against observations - Area 2	(1978-1995)
Table 2	GM verification against analyses - Area 2	(1967-1995)
Table 3	GM verification against analyses - N.H.	(1983-1995)
Table 4	GM verification against analyses - Tropics	(1983-1995)
Table 5	GM verification against analyses - S.H.	(1983-1995)
Table 6	LAM rainfall verification - tables	(1995)
Table 7	LAM rainfall verification - scores	(1988-1995)
Table 8	Mesoscale model rainfall verification	(1995)
Table 9	Mesoscale model verification against observations	(1993-1995)
Table 10	GM, LAM and CFO 48-point scheme	(1957-1995)
Table 11	LAM and CFO London precipitation	(1962-1995)
Table 12	BBC Radio verification	(1980-1995)
Table 13	Global Wave Model verification	(1988-1995)
Table 14	European Wave Model verification	(1988-1995)

(GM refers to Global Model, LAM to Limited Area Model)

The Figures

A selection of the statistics given in the tables is also presented graphically in the form of time-series. A summary is given below:

Figure 3 Verification against observations - Area 2
- a) rms error of PMSL
- b) mean error of PMSL

Figure 4 Verification against analyses - Area 2
- a) rms error of 500 hPa geopotential height
- b) mean error of 500 hPa geopotential height

Figure 5 Verification against analyses - Area 2
- a) rms vector wind error at 500 hPa
- b) rms vector wind error at 200 hPa

Figure 6 Verification against analyses - Northern Hemisphere
- a) rms error of PMSL
- b) rms vector wind error at 200 hPa

Figure 7 Verification against analyses - Tropics
- a) rms vector wind error at 850 hPa
- b) rms vector wind error at 200 hPa

Figure 8 Verification against analyses - Southern Hemisphere
- a) rms error of PMSL
- b) rms vector wind error at 200 hPa

Figure 9 48-point verification (CFO v. Global v. Limited Area)
- a) rms error of 1000 hPa geopotential height
- b) rms vector wind error at 1000 hPa
- c) 1000 hPa height change correlation
- d) 1000 hPa wind stretch vector correlation

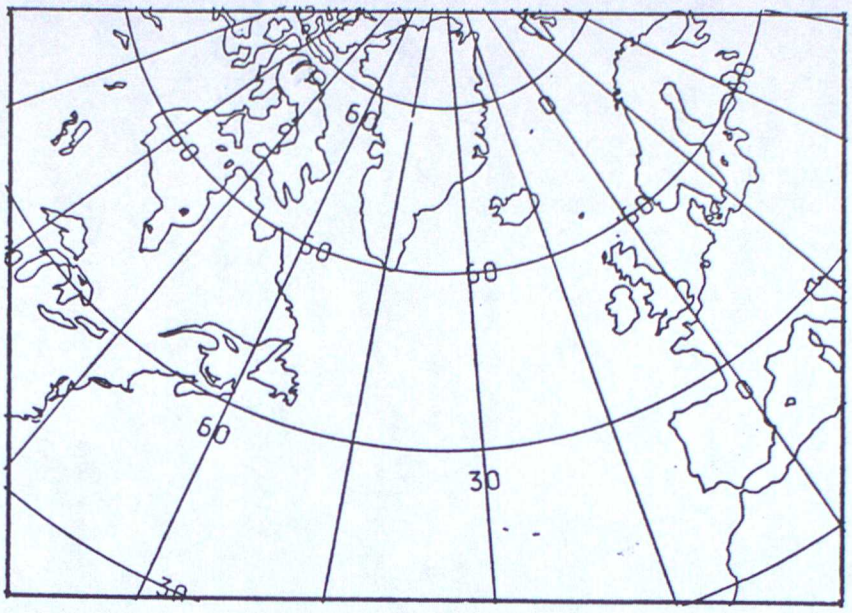

Figure 1. Area 2

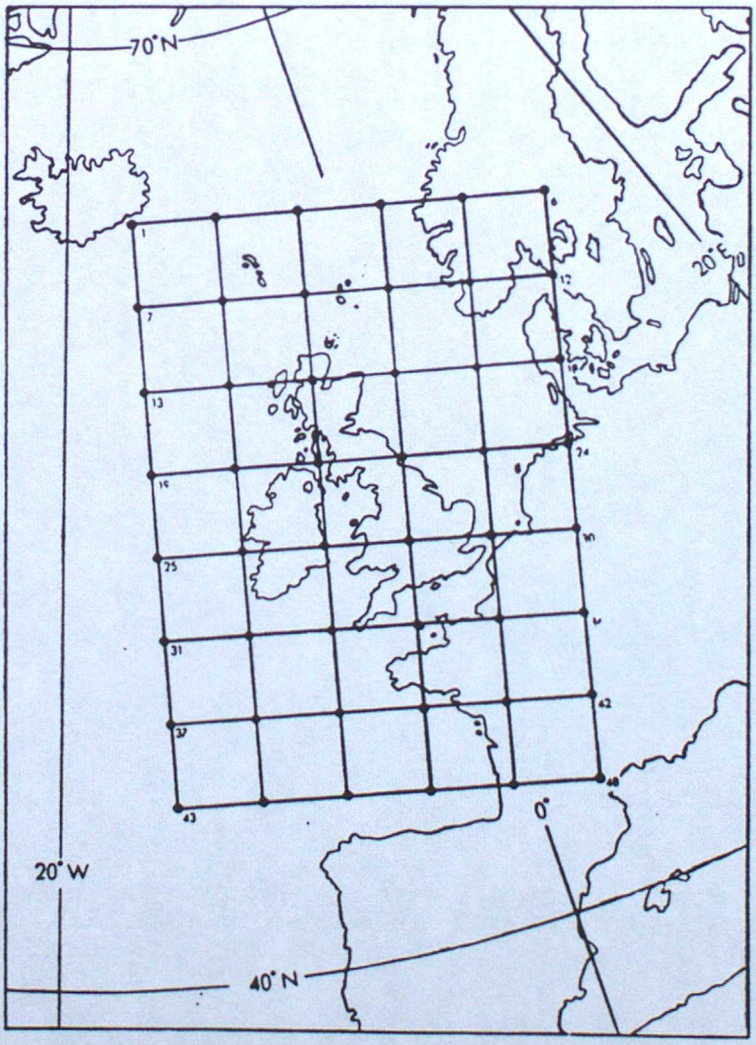

Figure 2. 48-Point Verification Area

TABLE 1: ANNUAL MEAN STATISTICS FOR AREA 2

VERIFICATION AGAINST OBSERVATIONS

	ANALYSES			24-HR F/C			48-HR F/C			72-HR F/C		
	H200	H500	PMSL	H200	H500	PMSL	H200	H500	PMSL	H200	H500	PMSL
1978	32	15	15	51	35	38	76	57	56	88	79	74
1979	32	16	14	50	34	35	75	57	55	87	79	74
1980	30	16	14	47	33	34	70	55	53	82	77	70
1981	28	15	14	47	34	35	70	56	55	86	75	72
1982	30	17	19	44	32	35	65	51	53	82	73	71
1983	30	20	17	41	30	31	60	48	48	78	72	69
1984	26	18	18	37	28	30	55	47	47	81	69	66
1985	25	16	17	35	26	29	50	42	43	71	61	59
1986	28	16	16	37	26	28	52	40	42	70	55	55
1987	28	17	17	37	25	28	52	40	41	72	58	56
1988	28	17	22	36	25	31	50	40	43	70	57	57
1989	28	17	17	36	26	27	51	41	40	72	58	54
1990	26	17	17	35	26	27	50	41	41	71	57	55
1991	27	16	16	38	25	26	55	39	40	77	57	55
1992†	27	16	15	43	25	26	60	39	39	79	55	53
1993	22	14	14	34	22	24	50	36	37	71	54	52
1994	24	14	14	34	22	23	49	37	37	66	53	52
1995	21	13	13	29	20	21	42	31	33	59	47	47

Table 1(a) Rms errors of the forecast for geopotential height at 200 and 500 hPa (H200 and H500, in metres) and PMSL (in tenths of hPa). († 1992 figures are for the 12-month period Nov'91-Oct'92)

	ANALYSES			24-HR F/C			48-HR F/C			72-HR F/C		
	H200	H500	PMSL	H200	H500	PMSL	H200	H500	PMSL	H200	H500	PMSL
1978	-2	1	0	-5	-2	6	-15	-8	1	-20	-9	3
1979	-1	1	0	-8	-4	5	-18	-10	-1	-24	-11	1
1980	0	1	-1	-3	-2	5	-10	-7	-2	-13	-6	-2
1981	0	2	-1	-3	-2	5	-10	-8	-2	-15	-9	-1
1982	-4	-1	-1	-6	-3	0	-12	-8	-4	-20	-12	-7
1983	-12	-10	0	-10	-13	-4	-20	-23	-12	-34	-35	-23
1984	-10	-10	3	-10	-12	0	-18	-22	-8	-30	-33	-18
1985	-6	-6	2	-6	-9	2	-12	-16	-3	-18	-22	-4
1986	1	-2	1	0	-6	0	-6	-12	-4	-10	-14	-3
1987	3	-2	2	1	-7	4	-9	-17	-2	-19	-25	-4
1988	2	-2	1	-1	-7	2	-8	-13	-1	-14	-17	-2
1989	0	-4	0	-5	-8	1	-11	-15	-1	-17	-19	-1
1990	-2	-5	0	-7	-10	0	-13	-15	-1	-19	-20	-1
1991	-9	-6	0	-19	-10	0	-28	-14	-1	-37	-17	-3
1992†	-13	-6	0	-29	-12	1	-41	-15	0	-48	-16	1
1993	-7	-2	1	-19	-8	-1	-28	-14	-4	-36	-18	-4
1994	-7	-2	1	-19	-9	-2	-29	-16	-6	-33	-18	-7
1995	-6	-2	1	-13	-2	4	-18	-4	4	-20	-3	5

Table 1(b) Mean errors of the forecast for geopotential height at 200 and 500 hPa (H200 and H500, in metres) and PMSL (in tenths of hPa). († 1992 figures are for the 12-month period Nov'91-Oct'92)

	ANALYSES		24-HR F/C		48-HR F/C		72-HR F/C	
	W200	W500	W200	W500	W200	W500	W200	W500
1978	12	11	17	15	23	20	28	24
1979	12	11	17	15	23	20	28	25
1980	12	11	17	15	22	19	27	24
1981	12	11	17	15	22	20	27	24
1982	11	10	16	15	21	19	26	23
1983	8	7	15	13	19	17	25	22
1984	8	7	14	13	19	17	24	22
1985	9	8	14	13	18	17	22	21
1986	9	8	14	13	18	16	22	20
1987	9	8	13	12	18	16	22	20
1988	9	8	13	12	17	16	22	20
1989	10	8	13	12	17	16	22	20
1990	9	8	13	12	17	16	22	20
1991	9	8	12	11	17	15	22	20
1992†	8	8	12	12	16	16	22	20
1993	8	7	12	11	16	15	21	20
1994	8	7	12	11	16	15	21	19
1995	8	7	11	11	15	14	20	19

Table 1(c) Rms vector wind errors of the forecasts at 200 and 500 hPa (W200 and W500) in knots.
(† 1992 figures are for the 12-month period Nov'91-Oct'92)

	ANALYSES			24-HR FORECAST			48-HR FORECAST		
	T200	T500	SURF	T200	T500	SURF	T200	T500	SURF
1978	2.9	1.5	4.6	3.6	1.9	4.3	4.6	2.7	4.9
1979	2.9	1.5	4.4	3.7	1.9	4.2	4.7	2.7	4.8
1980	2.9	1.4	4.3	3.7	1.9	4.1	4.7	2.6	4.6
1981	2.8	1.4	4.3	3.6	1.9	4.0	4.5	2.7	4.5
1982	2.5	1.3	3.9	3.3	1.8	4.0	4.1	2.5	4.5
1983	1.8	0.9	2.8	2.7	1.7	3.6	3.2	2.3	3.9
1984	1.8	0.9	2.7	2.5	1.6	3.2	3.2	2.3	3.6
1985	1.8	0.9	2.9	2.5	1.6	3.3	3.0	2.2	3.7
1986	1.9	0.9	2.9	2.5	1.6	3.2	3.1	2.2	3.6
1987	1.9	1.0	2.8	2.5	1.6	3.2	3.1	2.2	3.6
1988	1.9	1.0	2.9	2.5	1.6	3.3	3.1	2.2	3.6
1989	2.0	1.1	2.9	2.5	1.6	3.2	3.0	2.2	3.5
1990	1.9	1.1	2.9	2.4	1.6	3.2	3.0	2.2	3.5
1991	1.6	1.0	2.8	2.2	1.5	3.1	2.8	2.0	3.4
1992†	1.6	1.0	2.7	2.1	1.5	2.9	2.7	2.1	3.2
1993	1.4	0.9	2.7	2.0	1.3	3.0	2.6	1.9	3.3
1994	1.4	0.9	2.8	2.0	1.3	2.9	2.7	1.9	3.2
1995	1.4	0.9	2.7	2.0	1.3	2.8	2.5	1.8	3.0

Table 1(d) Rms errors of the forecasts of temperature at 200 and 500 hPa (T200 and T500) and at 1.5M above the surface (SURF), all in degrees K.
(† 1992 figures are for the 12-month period Nov'91-Oct'92)

	ANALYSES			24-HR FORECAST			48-HR FORECAST		
	T200	T500	SURF	T200	T500	SURF	T200	T500	SURF
1978	-1.2	-0.2	-0.2	-1.7	-0.1	-1.0	-2.2	-0.1	-1.2
1979	-1.1	-0.3	-0.3	-1.8	-0.2	-1.2	-2.3	-0.1	-1.5
1980	-1.3	-0.3	-0.1	-1.9	-0.1	-1.2	-2.5	0.1	-1.4
1981	-1.1	-0.2	0.0	-1.6	-0.1	-1.1	-2.0	0.0	-1.4
1982	-0.6	-0.2	0.0	-0.9	-0.1	-0.4	-1.2	-0.1	-0.5
1983	0.3	-0.3	-0.6	0.5	-0.3	-0.1	0.5	-0.4	-0.1
1984	0.3	-0.3	-0.8	0.4	-0.3	-0.7	0.3	-0.4	-0.8
1985	0.2	-0.3	-0.7	0.3	-0.3	-0.6	0.2	-0.4	-0.6
1986	0.5	-0.2	-0.9	0.6	-0.3	-0.7	0.6	-0.4	-0.7
1987	0.6	-0.3	-1.1	0.8	-0.4	-1.0	0.8	-0.6	-1.1
1988	0.5	-0.2	-0.8	0.6	-0.3	-0.8	0.6	-0.4	-0.9
1989	0.5	-0.2	-0.8	0.5	-0.4	-0.8	0.5	-0.6	-0.9
1990	0.4	-0.2	-0.9	0.4	-0.4	-0.9	0.4	-0.6	-0.9
1991	0.4	-0.2	-0.7	0.4	-0.4	-0.7	0.2	-0.5	-0.7
1992†	0.2	-0.2	-0.9	0.3	-0.5	-1.0	0.2	-0.7	-1.1
1993	0.3	-0.1	-1.0	0.5	-0.2	-1.3	0.5	-0.3	-1.4
1994	0.2	-0.1	-1.2	0.5	-0.3	-1.2	0.6	-0.3	-1.3
1995	0.2	-0.1	-0.9	0.4	-0.2	-1.0	0.4	-0.2	-1.1

Table 1(e) Mean errors of the forecasts of temperature at 200 and 500 hPa (T200 and T500) and at 1.5M above the surface (SURF), all in degrees K. († 1992 figures are for the 12-month period Nov'91-Oct'92)

TABLE 2: ANNUAL MEAN STATISTICS FOR AREA 2

VERIFICATION AGAINST ANALYSES

	24-HR FORECAST			48-HR FORECAST			72-HR FORECAST		
	H200	H500	PMSL	H200	H500	PMSL	H200	H500	PMSL
1967	54/***	42/**	44/**	97/***	76/***	73/***			
1968	51/***	42/**	44/**	90/***	72/***	73/***			
1969	50/***	42/**	42/**	86/***	71/***	71/***			
1970	50/***	43/**	43/**	86/***	71/***	72/***			
1971	54/***	45/**	44/**	91/***	77/***	75/***			
1972	54/***	44/**	45/**	96/***	75/***	75/***			
1973	50/ 84	39/73	43/72	87/126	68/107	70/ 98	120/144	94/123	89/108
1974	53/ 89	41/74	42/71	93/130	70/105	67/ 93	131/151	97/121	87/103
1975	53/ 94	41/78	41/72	90/137	69/112	65/ 97	125/159	94/128	84/108
1976	54/ 97	42/80	41/75	91/140	69/112	65/100	125/159	93/127	84/109
1977	54/ 99	40/81	39/72	83/145	65/116	61/ 98	112/168	88/134	79/110
1978	46/102	36/82	38/75	73/146	58/114	57/100	99/167	79/130	74/111
1979	45/ 99	35/81	36/74	71/146	58/116	54/100	98/169	80/133	74/112
1980	42/ 99	34/82	35/77	67/141	56/114	53/103	94/161	77/130	70/112
1981	42/100	34/83	36/75	68/145	56/116	54/101	95/165	76/131	71/110
1982	41/100	33/83	35/80	63/143	52/115	52/105	89/166	72/131	71/114
1983	36/ 98	27/80	34/81	55/144	43/114	50/108	79/168	63/130	69/119
1984	31/ 94	24/78	31/77	50/140	41/111	47/103	74/163	62/129	65/116
1985	30/ 94	23/78	29/77	48/138	40/111	44/104	70/161	59/129	60/116
1986	28/ 98	22/79	28/80	48/140	38/109	42/104	70/158	54/123	56/113
1987	28/ 95	22/76	26/77	49/140	39/108	42/102	72/163	57/125	57/112
1988	26/ 99	21/81	26/80	46/140	37/115	41/106	68/166	55/131	56/115
1989	25/100	19/80	24/82	46/143	36/111	40/106	69/164	55/128	56/116
1990	25/102	19/81	24/82	45/148	36/114	40/109	68/167	54/129	56/119
1991	26/ 97	18/78	22/78	47/143	35/110	38/103	70/165	54/127	55/113
1992	28/ 91	19/78	22/76	50/135	35/111	37/101	71/158	53/128	53/112
1993	24/ 91	17/76	20/75	43/136	33/107	35/100	64/158	51/125	51/111
1994	24/ 95	17/78	21/76	41/138	32/111	35/102	61/158	50/125	51/113
1995	20/ 92	15/75	18/75	36/137	29/108	31/103	55/160	45/126	45/115

Table 2(a) Rms errors of the forecast and persistence for geopotential height at 200 and 500 hPa (H200 and H500, in metres) and PMSL (in tenths of hPa).

	24-HR FORECAST			48-HR FORECAST			72-HR FORECAST		
	H200	H500	PMSL	H200	H500	PMSL	H200	H500	PMSL
1973	14/**	4/**	-2/**	23/**	5/**	-9/**	32/**	5/**	-18/**
1974	23/**	10/**	3/**	40/**	15/**	-1/**	55/**	19/**	-7/**
1975	25/**	11/**	3/**	43/**	15/**	-3/**	57/**	18/**	-11/**
1976	27/ 1	13/ 0	6/ 0	43/-1	18/ 0	1/ 0	57/-2	22/ 0	-6/ 0
1977	27/ 0	14/ 0	9/ 0	35/ 0	14/ 0	0/ 0	41/-1	14/ 0	-6/ 0
1978	-1/ 0	1/ 0	8/ 0	-11/ 0	-2/ 0	5/ 0	-14/-1	0/ 0	7/ 0
1979	-4/ 0	-1/ 0	6/ 0	-15/-1	-5/ 0	1/ 0	-19/-1	-4/ 0	2/ 0
1980	0/ 0	-1/ 0	7/ 0	-9/ 1	-5/ 0	2/ 0	-13/ 1	-4/ 0	3/ 0
1981	0/ 0	-1/ 0	7/ 0	-10/ 0	-6/ 0	2/ 1	-14/ 0	-6/ 1	3/ 2
1982	-3/ 0	-2/ 0	2/ 0	-10/ 1	-4/ 1	-2/ 0	-15/ 1	-6/ 1	-4/ 1
1983	-1/ 1	-3/ 1	-2/ 1	-9/ 2	-10/ 1	-9/ 2	-18/ 2	-17/ 2	-18/ 3
1984	0/ 0	-3/ 0	-1/ 0	-8/-1	-10/-1	-7/ 0	-18/-2	-19/-1	-15/ 0
1985	-1/-8	-2/ 0	1/-7	-9/-5	-9/ 0	-2/-7	-17/-3	-14/ 0	-4/-7
1986	-3/-1	-3/ 0	1/ 0	-10/-1	-8/-1	-1/-1	-15/-1	-11/-1	-2/-1
1987	-3/-1	-3/ 0	3/ 0	-13/-1	-9/-1	0/-1	-22/-1	-15/-1	-2/-1
1988	-4/ 0	-3/ 0	3/ 0	-13/ 0	-9/ 0	1/ 0	-22/ 1	-15/ 1	-2/ 0
1989	-7/ 0	-4/ 0	2/ 0	-14/-1	-9/-1	0/ 0	-20/-1	-14/-1	-2/ 0
1990	-7/ 0	-5/ 0	1/ 0	-14/ 1	-9/ 0	0/ 0	-20/ 1	-13/ 0	-2/ 0
1991	-12/ 0	-4/ 0	1/ 0	-22/ 0	-7/ 0	1/-1	-30/ 0	-10/ 0	0/ 0
1992	-17/ 0	-6/ 0	0/ 0	-29/ 1	-9/ 0	0/ 0	-37/ 1	-10/ 1	0/ 0
1993	-14/ 0	-6/ 0	-1/ 0	-23/ 0	-10/ 0	-2/ 0	-30/ 0	-13/ 0	-3/ 0
1994	-14/ 0	-6/ 0	-2/ 0	-22/ 0	-10/ 0	-4/ 0	-27/ 0	-13/ 0	-7/ 0
1995	-9/ 0	-1/ 0	2/ 0	-13/ 1	-2/ 0	4/ 0	-16/ 1	-1/ 0	5/ 0

Table 2(b) Mean errors of the forecast for geopotential height and persistence at 200 and 500 hPa (H200 and H500, in metres) and PMSL (in tenths of hPa).

	24-HR FORECAST			48-HR FORECAST			72-HR FORECAST		
	W200	W500	SURF	W200	W500	SURF	W200	W500	SURF
1967	21/**	17/**		31/**	25/**				
1968	20/**	17/**		29/**	25/**				
1969	19/**	17/**		29/**	25/**				
1970	20/**	18/**		29/**	26/**				
1971	20/**	19/**		30/**	27/**				
1972	21/**	18/**		29/**	26/**				
1973	16/27	15/25		23/36	22/32		29/39	27/35	
1974	16/28	15/25		23/37	21/31		29/40	27/34	
1975	17/29	16/27		24/38	22/34		30/41	28/36	
1976	17/30	16/27		23/39	22/33		30/41	26/35	
1977	16/31	14/27	7/12	22/40	19/34	9/15	27/43	24/37	11/16
1978	16/31	14/28	7/12	22/40	19/34	9/14	27/43	23/37	11/15
1979	16/31	14/27	7/12	21/40	19/35	9/14	27/44	24/37	11/15
1980	15/31	13/28	6/13	20/39	18/34	8/15	26/42	23/36	10/16
1981	15/31	13/28	7/12	21/41	18/35	9/15	26/43	23/37	10/15
1982	16/33	14/29	8/14	20/41	19/36	9/16	26/45	23/38	11/17
1983	16/35	14/31	8/15	20/44	18/37	10/17	25/48	22/39	11/18
1984	14/34	13/29	7/13	19/43	17/35	9/15	24/46	21/38	10/16
1985	14/33	13/29	6/12	18/41	16/35	8/14	23/44	23/37	9/14
1986	13/34	11/29	7/13	17/42	15/34	8/15	22/44	22/36	10/16
1987	12/32	11/27	7/14	17/41	15/33	9/16	22/45	22/36	11/17
1988	11/33	10/28	6/14	16/42	14/35	8/16	21/44	21/36	10/16
1989	10/32	8/27	6/14	15/40	13/32	8/15	20/43	18/35	10/16
1990	10/33	8/27	5/13	15/42	13/34	8/15	21/44	18/35	10/16
1991	10/32	8/27	5/13	15/41	13/33	7/15	21/45	18/35	10/15
1992	10/31	8/27	5/13	16/40	13/33	7/15	21/43	19/36	9/15
1993	10/32	8/27	5/13	15/41	13/33	7/15	20/44	18/35	9/16
1994	10/33	8/27	5/13	15/42	13/33	7/15	20/45	18/35	9/16
1995	9/32	7/26	4/13	14/41	12/32	6/15	19/44	17/34	8/16

Table 2(c) Rms vector wind errors of the forecasts at 200 and 500 hPa (W200 and W500) and at 10M above the surface (SURF), all in knots.

TABLE 3: ANNUAL MEAN STATISTICS FOR THE NORTHERN HEMISPHERE

VERIFICATION AGAINST ANALYSES

	T+24	T+48	T+72	T+96	T+120	T+144
1984	34/72	50/96	66/107	81/112	94/115	107/117
1985	32/72	45/97	58/107	71/109	83/111	92/112
1986	30/74	44/96	55/104	70/110	81/114	92/116
1987	29/72	43/96	56/107	68/113	81/118	91/121
1988	28/73	42/97	55/106	68/111	79/114	88/117
1989	25/72	40/96	54/106	67/112	78/117	89/120
1990	24/68	38/93	52/102	64/107	76/111	85/113
1991	23/67	38/90	51/100	64/105	76/109	86/112
1992	23/65	37/89	50/ 98	63/103	75/106	85/108
1993	22/65	35/89	48/ 99	60/103	72/106	84/108
1994	21/65	35/88	47/ 97	60/103	72/108	84/109
1995	18/65	30/89	41/ 99	53/105	65/108	76/111

Table 3(a) Rms errors of the forecast and persistence for PMSL (in tenths of hPa).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	-1	-5	-9	-11	-11	-14
1985	0	-2	-3	-3	-2	-3
1986	1	-2	-3	-3	-3	-3
1987	1	0	0	0	1	0
1988	0	0	0	-1	-1	-2
1989	1	1	1	1	2	2
1990	1	2	1	1	2	1
1991	0	-1	-1	-1	-1	-2
1992	-3	-4	-4	-3	-4	-4
1993	-2	-4	-4	-4	-4	-5
1994	-3	-5	-5	-5	-6	-6
1995	1	0	1	3	4	4

Table 3(b) Mean errors of the forecast for PMSL (in tenths of hPa).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	25/69	40/ 98	58/113	75/120	91/126	105/130
1985	23/70	38/ 99	54/115	69/119	83/122	95/124
1986	22/71	37/100	51/112	66/122	80/128	93/133
1987	22/70	36/ 99	52/115	67/124	82/131	95/135
1988	21/71	36/101	51/114	66/123	80/130	93/134
1989	18/69	34/ 99	50/115	66/125	80/132	93/136
1990	17/65	32/ 95	47/108	62/116	75/122	86/125
1991	17/65	31/ 94	46/108	62/117	77/123	90/129
1992	17/64	31/ 93	45/107	60/115	75/120	88/123
1993	16/64	30/ 92	44/106	59/113	74/119	89/124
1994	16/65	29/ 92	43/106	58/114	74/120	88/124
1995	14/63	25/ 91	38/106	52/116	67/122	81/127

Table 3(c) Rms errors of the forecast and persistence for geopotential height at 500 hPa (in metres).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	-3	-9	-13	-16	-18	-21
1985	-3	-8	-12	-14	-16	-18
1986	-4	-8	-10	-12	-14	-15
1987	-4	-8	-11	-14	-16	-19
1988	-5	-10	-13	-17	-20	-23
1989	-4	-8	-11	-13	-15	-18
1990	-4	-7	-10	-13	-15	-18
1991	-3	-5	-7	-9	-10	-12
1992	-6	-8	-9	-9	-10	-11
1993	-5	-8	-10	-11	-13	-14
1994	-5	-8	-9	-10	-11	-12
1995	-1	-2	-1	0	0	0

Table 3(d) Mean errors of the forecast for geopotential height at 500 hPa (in metres).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	12/20	15/23	17/24	19/25	21/25	23/25
1985	12/20	14/23	16/24	18/24	20/24	21/25
1986	11/20	14/23	16/24	18/25	19/25	21/25
1987	10/20	13/23	15/24	17/24	19/25	21/25
1988	10/19	12/22	15/23	17/24	18/24	20/24
1989	8/18	11/21	13/22	16/23	18/23	19/24
1990	8/18	11/21	13/22	16/23	18/23	19/23
1991	7/17	10/21	13/22	16/22	18/23	19/23
1992	7/17	10/20	13/21	15/22	18/22	19/23
1993	6/17	9/20	12/21	15/22	17/22	19/23
1994	6/17	9/20	12/21	14/22	17/23	19/23
1995	5/16	8/20	11/21	14/22	16/22	18/22

Table 3(e) Rms vector wind errors of the wind forecasts at 850 hPa (in knots).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	15/32	19/40	24/42	29/44	33/45	36/46
1985	15/31	19/39	23/42	27/44	31/44	34/44
1986	13/32	18/40	22/42	26/44	30/45	33/46
1987	13/31	17/40	21/42	26/45	30/46	33/47
1988	12/32	17/40	21/42	26/44	30/46	33/46
1989	10/30	15/38	20/41	25/44	29/45	33/46
1990	10/29	15/38	20/41	25/42	29/44	32/45
1991	10/29	15/38	20/41	25/43	30/44	34/45
1992	10/28	15/37	20/40	25/42	29/43	34/44
1993	10/29	15/38	19/41	24/42	29/43	33/44
1994	10/30	14/39	19/42	25/43	30/43	34/45
1995	9/30	14/38	19/41	24/43	28/45	33/45

Table 3(f) Rms vector wind errors of the wind forecasts at 200 hPa (in knots).

TABLE 4: ANNUAL MEAN STATISTICS FOR THE TROPICS

VERIFICATION AGAINST ANALYSES

	T+24	T+48	T+72	T+96	T+120	T+144
1984	11/12	12/15	13/15	14/16	14/16	15/16
1985	10/12	12/14	13/15	14/15	14/15	14/16
1986	10/12	11/15	12/15	13/16	13/16	14/16
1987	9/11	11/13	12/14	12/15	13/15	13/15
1988	9/11	10/13	11/14	12/14	12/14	13/15
1989	7/ 9	9/12	10/12	11/13	12/13	12/13
1990	7/ 9	9/12	10/13	11/13	12/13	12/14
1991	6/ 8	8/11	10/12	11/12	11/13	12/13
1992	5/ 8	7/11	9/11	10/12	11/12	12/12
1993	5/ 8	7/10	8/11	9/12	10/12	11/12
1994	5/ 8	7/10	8/11	9/12	10/12	11/12
1995	4/ 7	6/10	7/11	8/11	9/11	10/11

Table 4(a) Rms vector wind errors of the wind forecasts at 850 hPa (in knots).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	16/21	19/27	22/29	24/30	25/31	27/31
1985	15/21	18/26	20/29	22/30	24/30	25/31
1986	14/20	18/26	20/28	21/30	23/31	24/31
1987	14/19	17/25	19/27	20/29	22/30	23/30
1988	13/19	16/25	18/27	20/29	22/30	23/30
1989	11/16	14/23	17/25	19/27	21/28	22/28
1990	10/16	14/22	17/25	19/27	20/28	22/28
1991	11/18	16/24	19/27	22/28	24/29	26/30
1992	10/17	15/23	18/26	21/27	23/28	25/29
1993	9/16	14/22	17/26	20/27	22/27	24/28
1994	9/16	13/22	17/25	19/27	21/27	24/28
1995	9/16	13/22	17/25	19/26	21/27	23/28

Table 4(b) Rms vector wind errors of the wind forecasts at 200 hPa (in knots).

TABLE 5: ANNUAL MEAN STATISTICS FOR THE SOUTHERN HEMISPHERE

VERIFICATION AGAINST ANALYSES

	T+24	T+48	T+72	T+96	T+120	T+144
1984	42/81	61/107	77/118	90/122	100/126	109/127
1985	40/84	59/110	73/120	86/122	97/124	105/125
1986	41/85	60/112	75/124	88/131	99/136	107/139
1987	38/83	55/110	70/122	82/128	92/131	99/134
1988	36/82	54/110	69/121	81/127	91/130	100/132
1989	33/85	52/112	68/122	81/129	92/133	101/133
1990	31/81	49/109	65/120	78/126	89/129	98/131
1991	31/79	50/107	66/119	80/126	92/130	102/133
1992	29/78	47/106	64/118	78/123	91/128	101/130
1993	27/79	45/108	61/120	75/127	88/131	99/133
1994	27/78	45/106	61/116	75/122	88/124	99/126
1995	26/78	42/105	58/116	73/122	87/126	98/128

Table 5(a) Rms errors of the forecast and persistence for PMSL (in tenths of hPa).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	2	2	3	2	0	0
1985	2	4	3	3	3	5
1986	3	4	3	4	5	7
1987	2	3	3	5	6	9
1988	3	4	4	5	7	10
1989	2	4	5	7	8	11
1990	2	3	4	5	6	7
1991	2	3	3	3	4	4
1992	3	4	3	4	3	3
1993	3	4	4	3	4	4
1994	2	2	1	0	0	0
1995	3	4	3	3	3	4

Table 5(b) Mean errors of the forecast for PMSL (in tenths of hPa).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	34/81	55/112	73/126	88/133	101/137	112/139
1985	32/81	52/112	69/125	85/127	98/128	108/129
1986	31/82	52/115	70/130	85/138	98/144	108/148
1987	29/82	49/114	65/129	79/136	91/139	101/142
1988	29/81	48/114	66/129	80/137	93/140	103/143
1989	27/86	47/118	65/132	81/141	94/145	104/146
1990	26/81	45/113	62/128	77/135	89/140	100/143
1991	26/81	46/114	64/130	81/139	95/145	107/148
1992	24/81	44/115	63/130	79/138	94/143	107/146
1993	23/82	42/116	60/132	77/142	92/147	105/150
1994	23/82	42/115	59/129	75/136	91/140	104/142
1995	22/81	39/113	57/128	74/135	90/141	104/143

Table 5(c) Rms errors of the forecast and persistence for geopotential height at 500 hPa (in metres).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	-1	-2	-3	-5	-9	-10
1985	-3	-7	-12	-16	-20	-21
1986	-2	-6	-10	-14	-16	-18
1987	-7	-11	-15	-19	-22	-23
1988	-5	-11	-17	-22	-26	-28
1989	-4	-8	-11	-15	-18	-20
1990	-4	-8	-13	-16	-19	-21
1991	-4	-8	-11	-14	-17	-18
1992	-4	-7	-10	-12	-13	-14
1993	-3	-6	-9	-12	-13	-13
1994	-3	-6	-9	-11	-11	-12
1995	-1	-3	-5	-6	-6	-6

Table 5(d) Mean errors of the forecast for geopotential height at 500 hPa (in metres).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	12/22	16/25	19/27	21/27	23/27	24/27
1985	12/22	16/25	18/26	20/26	22/26	23/27
1986	12/23	16/26	19/27	21/28	22/28	23/29
1987	11/22	15/25	17/27	19/27	21/27	21/27
1988	11/21	14/25	17/26	19/27	20/27	21/27
1989	8/21	12/25	16/26	18/26	20/27	21/26
1990	8/20	12/24	15/25	18/26	20/26	20/26
1991	8/20	12/24	16/25	18/26	21/27	22/27
1992	7/20	12/24	15/25	18/25	20/26	22/26
1993	7/20	11/24	15/26	18/26	20/27	22/27
1994	7/20	11/24	15/25	18/26	20/26	22/26
1995	7/20	11/23	15/25	18/25	20/26	22/26

Table 5(e) Rms vector wind errors of the wind forecasts at 850hPa (in knots).

	T+24	T+48	T+72	T+96	T+120	T+144
1984	14/32	20/40	25/43	30/44	33/45	36/45
1985	14/33	20/41	26/43	30/43	33/44	36/44
1986	14/33	20/41	25/44	29/45	33/46	35/47
1987	14/33	19/41	24/45	29/45	32/45	35/46
1988	13/33	19/43	24/46	28/47	32/47	34/47
1989	10/33	17/42	23/45	28/46	32/47	35/47
1990	10/32	17/41	23/44	27/45	31/46	34/46
1991	10/32	17/41	23/44	28/46	32/47	36/47
1992	10/31	16/40	22/43	27/45	32/45	36/46
1993	10/32	16/41	22/45	27/47	32/48	36/48
1994	10/32	16/42	22/45	27/46	32/47	36/47
1995	10/32	16/41	22/44	28/45	33/46	37/47

Table 5(f) Rms vector wind errors of the wind forecasts at 200hPa (in knots).

TABLE 6: VERIFICATION OF LIMITED AREA MODEL PRECIPITATION FORECAST

FORECAST PERIOD 0-6

FORECAST \ Observed	O	L	M	H	All
O	56.8	7.1	0.7	0.0	64.6
L	13.1	11.1	3.1	0.2	27.5
M	1.1	2.5	3.3	0.5	7.4
H	0.0	0.0	0.2	0.2	0.5
All	71.1	20.7	7.3	0.9	100.0

FORECAST PERIOD 6-12

FORECAST \ Observed	O	L	M	H	All
O	53.0	6.4	0.6	0.0	60.0
L	15.3	13.6	3.1	0.3	32.3
M	0.9	2.7	3.2	0.5	7.3
H	0.0	0.1	0.3	0.1	0.5
All	69.2	22.8	7.2	0.9	100.0

FORECAST PERIOD 12-18

FORECAST \ Observed	O	L	M	H	All
O	51.8	5.7	0.7	0.0	58.2
L	17.6	12.0	3.2	0.1	33.0
M	1.7	2.9	3.1	0.6	8.2
H	0.0	0.1	0.3	0.2	0.6
All	71.1	20.7	7.3	0.9	100.0

FORECAST PERIOD 18-24

FORECAST \ Observed	O	L	M	H	All
O	50.5	5.8	0.5	0.0	56.8
L	16.9	13.7	3.6	0.3	34.4
M	1.8	3.2	2.8	0.5	8.2
H	0.0	0.2	0.3	0.1	0.6
All	69.2	22.8	7.2	0.9	100.0

FORECAST PERIOD 24-30

FORECAST \ Observed	O	L	M	H	All
O	49.2	5.9	1.0	0.0	56.2
L	19.2	11.7	3.5	0.2	34.6
M	2.7	3.0	2.5	0.4	8.6
H	0.1	0.1	0.2	0.2	0.6
All	71.1	20.7	7.3	0.9	100.0

FORECAST PERIOD 30-36

FORECAST \ Observed	O	L	M	H	All
O	48.8	6.3	1.0	0.0	56.1
L	17.8	13.1	3.6	0.3	34.9
M	2.5	3.1	2.3	0.4	8.3
H	0.1	0.2	0.3	0.1	0.7
All	69.2	22.8	7.2	0.9	100.0

Table 6(a) UK area. Contingency tables for 1995 with frequencies averaged over selected reporting stations and expressed as percentages (00Z & 12Z run data).
Key to precipitation classes:-
"O" = Nil pptn (less than 0.1 mm), "L" = Light (between 0.1 & 2.4 mm)
"M" = Moderate (between 2.4 & 10.4 mm), "H" = Heavy (10.4 mm or more)

FORECAST PERIOD 0-6

FORECAST \ Observed	O	L	M	H	All
O	66.9	3.6	0.6	0.1	71.3
L	13.6	6.7	2.4	0.4	23.1
M	1.2	1.5	2.0	0.5	5.1
H	0.1	0.1	0.2	0.2	0.5
All	81.7	11.9	5.2	1.1	100.0

FORECAST PERIOD 6-12

FORECAST \ Observed	O	L	M	H	All
O	66.2	2.9	0.4	0.0	69.5
L	14.9	7.6	1.9	0.2	24.6
M	1.3	1.8	2.0	0.3	5.4
H	0.1	0.1	0.2	0.1	0.5
All	82.4	12.4	4.5	0.7	100.0

FORECAST PERIOD 12-18

FORECAST \ Observed	O	L	M	H	All
O	63.5	3.1	0.5	0.1	67.3
L	16.6	6.8	2.4	0.4	26.2
M	1.5	1.9	2.1	0.5	5.9
H	0.1	0.1	0.2	0.2	0.6
All	81.7	11.9	5.2	1.1	100.0

FORECAST PERIOD 18-24

FORECAST \ Observed	O	L	M	H	All
O	63.9	2.8	0.3	0.0	67.0
L	16.7	7.6	2.1	0.2	26.6
M	1.7	2.0	1.8	0.3	5.8
H	0.1	0.1	0.2	0.1	0.5
All	82.4	12.4	4.5	0.7	100.0

FORECAST PERIOD 24-30

FORECAST \ Observed	O	L	M	H	All
O	62.6	3.3	0.7	0.1	66.7
L	17.0	6.6	2.5	0.4	26.5
M	2.0	1.9	1.8	0.4	6.1
H	0.1	0.1	0.2	0.2	0.6
All	81.7	11.9	5.2	1.1	100.0

FORECAST PERIOD 30-36

FORECAST \ Observed	O	L	M	H	All
O	63.0	3.1	0.5	0.1	66.7
L	17.0	7.2	2.1	0.2	26.6
M	2.2	2.0	1.6	0.3	6.1
H	0.1	0.2	0.2	0.1	0.6
All	82.4	12.4	4.5	0.7	100.0

Table 6(b) Europe. Contingency tables for 1995 with frequencies averaged over selected reporting stations and expressed as percentages (00Z & 12Z run data).

TABLE 7: LIMITED AREA MODEL PRECIPITATION FORECAST SCORES

	FORECAST PERIOD					
	0-6	6-12	12-18	18-24	24-30	30-36
1988	77.9	77.0	74.7	74.5	72.4	72.0
1989	80.6	79.7	77.9	77.4	77.4	75.5
1990	79.2	78.6	76.9	76.3	75.2	74.6
1991	80.6	79.5	77.0	75.8	73.7	72.7
1992	80.6	79.2	76.6	74.4	72.1	70.8
1993	80.9	79.4	75.7	74.4	71.6	70.3
1994	78.9	77.2	73.4	73.5	70.6	70.7
1995	78.0	76.9	74.3	75.0	71.1	72.3

Table 7(a) Percentage Correct, UK area. Percentage of events correctly forecast, based on Rain/No Rain criterion, as in Table 6(a).

	FORECAST PERIOD					
	0-6	6-12	12-18	18-24	24-30	30-36
1988	80.2	79.4	78.5	77.6	76.9	75.8
1989	82.6	81.3	80.8	79.7	79.1	77.9
1990	82.6	81.7	80.7	79.5	79.0	77.8
1991	82.4	81.5	80.0	78.9	77.9	77 0
1992	83.5	82.3	80.5	79.0	77.8	76.6
1993	82.7	81.4	78.8	77.8	76.2	75.1
1994	81.8	80.8	77.9	77.4	75.4	74.9
1995	80.9	80.5	78.0	78.4	76.8	76.9

Table 7(b) Percentage Correct, Europe. Percentage of events correctly forecast, based on Rain/No Rain criterion, as in Table 6(b).

	FORECAST PERIOD					
	0-6	6-12	12-18	18-24	24-30	30-36
1988	1.0	1.1	1.2	1.2	1.3	1.2
1989	1.0	1.1	1.2	1.2	1.3	1.2
1990	1.0	1.0	1.1	1.1	1.1	1.1
1991	0.9	1.1	1.2	1.3	1.3	1.3
1992	0.9	1.1	1.3	1.3	1.4	1.4
1993	1.0	1.2	1.4	1.4	1.6	1.5
1994	1.1	1.3	1.5	1.5	1.5	1.5
1995	1.2	1.3	1.4	1.4	1.5	1.4

Table 7(c) Bias, UK area. Number of occasions on which rain was forecast as a ratio of the number of occasions on which rain was observed, as in Table 6(a).

	FORECAST PERIOD					
	0-6	6-12	12-18	18-24	24-30	30-36
1988	1.3	1.4	1.4	1.4	1.4	1.5
1989	1.3	1.4	1.4	1.5	1.4	1.5
1990	1.2	1.4	1.3	1.5	1.4	1.5
1991	1.2	1.5	1.4	1.6	1.5	1.7
1992	1.1	1.5	1.5	1.7	1.6	1.8
1993	1.2	1.6	1.7	1.8	1.8	1.9
1994	1.3	1.6	1.6	1.8	1.8	1.9
1995	1.6	1.7	1.8	1.9	1.8	1.9

Table 7(d) Bias, Europe. Number of occasions on which rain was forecast as a ratio of the number of occasions on which rain was observed, as in Table 6(b).

TABLE 8: VERIFICATION OF MESOSCALE MODEL PRECIPITATION FORECAST

FORECAST PERIOD 0-6

FORECAST \ Observed	O	L	M	H	All
O	55.6	7.2	0.4	0.0	63.3
L	12.3	13.4	2.2	0.1	28.0
M	1.0	3.6	2.9	0.4	7.9
H	0.0	0.1	0.4	0.3	0.8
All	68.9	24.3	6.0	0.8	100.0

FORECAST PERIOD 6-12

FORECAST \ Observed	O	L	M	H	All
O	52.9	4.4	0.6	0.1	58.0
L	17.0	11.5	3.0	0.2	31.6
M	1.7	3.4	3.6	0.4	9.1
H	0.1	0.1	0.7	0.3	1.2
All	71.7	19.5	7.9	0.9	100.0

FORECAST PERIOD 12-18

FORECAST \ Observed	O	L	M	H	All
O	53.7	6.0	0.6	0.0	60.4
L	14.7	12.8	2.5	0.2	30.2
M	1.4	3.7	2.6	0.5	8.3
H	0.1	0.2	0.5	0.3	1.1
All	69.9	22.8	6.3	1.0	100.0

FORECAST PERIOD 18-24

FORECAST \ Observed	O	L	M	H	All
O	52.7	5.9	0.8	0.1	59.5
L	16.5	11.0	3.1	0.1	30.6
M	2.0	3.5	3.2	0.3	8.9
H	0.1	0.1	0.5	0.3	1.0
All	71.3	20.5	7.5	0.7	100.0

FORECAST PERIOD 24-30

FORECAST \ Observed	O	L	M	H	All
O	50.0	6.5	0.7	0.1	57.3
L	16.7	13.2	2.4	0.2	32.5
M	2.1	4.4	2.5	0.4	9.3
H	0.1	0.2	0.4	0.2	0.9
All	68.9	24.3	6.0	0.8	100.0

Table 8 Contingency tables for 1994 with frequencies averaged over selected reporting stations and expressed as percentages (06Z run data).
Key to precipitation classes:-
"O" = Nil pptn (less than 0.1 mm), "L" = Light (between 0.1 & 2.4 mm)
"M" = Moderate (between 2.4 & 10.4 mm), "H" = Heavy (10.4 mm or more)

TABLE 9: ANNUAL MEAN STATISTICS FOR THE UK MESOSCALE MODEL

VERIFICATION AGAINST OBSERVATIONS

	FORECAST PERIOD				
	0-6	6-12	12-18	18-24	24-30
1993	79.3	76.6	77.2	75.0	72.9
1994	78.5	75.0	74.6	70.7	71.3
1995	79.0	76.1	77.1	74.7	73.8

Table 9(a) Precipitation: Percentage Correct. Percentage of events correctly forecast, based on Rain/No Rain criterion, as in Table 8 (06Z run data).

	FORECAST PERIOD				
	0-6	6-12	12-18	18-24	24-30
1993	1.04	1.40	1.19	1.33	1.36
1994	1.09	1.43	1.36	1.48	1.42
1995	1.18	1.48	1.32	1.41	1.37

Table 9(b) Precipitation: Bias. Number of occasions on which rain was forecast as a ratio of the number of occasions on which rain was observed, as in Table 8 (06Z run data).

	MEAN ERROR (SURF)				RMS ERROR (SURF)			
	T+6	T+12	T+18	T+24	T+6	T+12	T+18	T+24
1993	-0.31	-0.27	-0.04	0.18	1.83	1.68	1.68	1.80
1994	-0.63	-0.42	0.17	0.30	1.83	1.74	1.68	1.71
1995	0.03	0.28	0.68	0.76	1.75	1.68	1.83	1.99

Table 9(c) Mean and RMS errors of 1.5M temperature forecasts (in degrees K) from the Mesoscale Model (06Z run data).

	MEAN ERROR				RMS ERROR			
	T+6	T+12	T+18	T+24	T+6	T+12	T+18	T+24
1993	-0.79	-0.48	0.11	0.03	2.73	2.80	2.93	2.81
1994	-0.01	0.57	1.17	0.88	2.33	2.53	3.00	2.81
1995	-0.42	-0.13	0.43	0.11	2.34	2.43	2.89	2.76

Table 9(d) Mean and RMS errors of total cloud amount forecasts (in oktas) from the Mesoscale Model (06Z run data).

	MEAN SPEED ERROR (SURF)				RMS VECTOR WIND ERROR (SURF)			
	T+6	T+12	T+18	T+24	T+6	T+12	T+18	T+24
1993	-1.30	-0.23	0.84	0.74	6.49	6.53	6.55	6.85
1994	-1.71	-0.62	0.21	0.25	6.74	6.74	6.95	7.25
1995	-1.60	-0.45	0.44	0.44	5.47	5.76	5.92	6.09

Table 9(e) Mean speed and RMS vector wind errors of 10M wind forecasts (in knots) from the Mesoscale Model (06Z run data).

TABLE 10: 48-POINT VERIFICATION SCHEME

Year	Rms Ht Error	Rms Vector Wind Error	Ht Change Corr	Stretch Vector Corr	Ht/Ht Error Corr	F/C-Actual K.E. Equiv Wind	Rms F/C Ht Chge	Mean Ht Error	Rms Actual Wind
1957	45	16	0.67	0.63	-0.18	3	53	-8	24
1958	44	16	0.67	0.64	-0.18	5	55	-12	23
1959	46	17	0.67	0.67	-0.20	-4	57	-12	24
1960	43	16	0.67	0.66	-0.24	-4	51	-11	23
1961	45	17	0.66	0.62	-0.26	-5	53	-10	24
1962	45	17	0.70	0.65	-0.25	-7	59	-8	24
1963	43	16	0.70	0.66	-0.19	-4	53	-10	24
1964	42	15	0.70	0.65	-0.22	-3	54	-8	23
1965	44	16	0.71	0.66	-0.21	-5	59	-8	23
1966	44	16	0.69	0.65	-0.21	-5	57	-9	24
1967	44	16	0.72	0.67	-0.26	-7	55	-9	25
1968	43	15	0.67	0.67	-0.26	-6	48	-11	23
1969	42	15	0.69	0.66	-0.22	-4	51	-10	23
1970	42	16	0.70	0.63	-0.20	-4	55	-9	24
1971	43	16	0.66	0.64	-0.26	-5	53	-5	22
1972	43	16	0.66	0.67	-0.26	-5	56	-5	24
1973	42	16	0.70	0.63	-0.21	3	60	-5	23
1974	43	17	0.68	0.64	-0.27	-8	57	-5	25
1975	38	14	0.74	0.69	-0.26	-7	55	-7	23
1976	39	14	0.73	0.69	-0.26	-8	53	-6	23
1977	35	13	0.79	0.74	-0.25	-8	58	-5	24
1978	33	13	0.79	0.75	-0.21	-7	56	-4	24
1979	35	13	0.82	0.74	-0.14	-9	63	-8	24
1980	32	12	0.84	0.77	-0.19	-5	61	-11	23
1981	33	13	0.83	0.74	-0.21	-7	62	-9	24
1982	32	13	0.84	0.77	-0.11	-4	63	-6	25
1983	28	11	0.87	0.81	-0.07	1	67	-9	25
1984	27	11	0.86	0.80	-0.05	4	59	-8	23
1985	27	11	0.87	0.81	-0.05	5	56	-9	23
1986	29	12	0.88	0.82	-0.00	7	69	-13	26
1987	23	10	0.90	0.83	-0.01	5	60	-5	22
1988	22	10	0.90	0.85	-0.08	2	62	-4	24
1989	24	11	0.90	0.83	0.00	4	60	-7	24
1990	22	10	0.91	0.84	-0.03	2	61	-7	25
1991	22	10	0.91	0.85	0.04	6	63	-5	24
1992	23	11	0.91	0.82	0.05	7	68	-2	24
1993	20	10	0.92	0.84	0.07	7	62	-2	24
1994	20	11	0.93	0.86	0.08	8	60	-3	25
1995	19	10	0.93	0.84	-0.07	4	62	2	24

Table 10(a) CFO T+24: Verification of CFO's 24-hour forecast of the geopotential height (in metres) and geostrophic wind (in knots) at 1000 hPa, valid at 00Z.

Year	Rms Ht Error	Rms Vector Wind Error	Ht Change Corr	Stretch Vector Corr	Ht/Ht Error Corr	F/C-Actual K.E. Equiv	Rms F/C Ht Chge	Mean Ht Error	Rms Actual Wind
1980	28	10	0.88	0.82	-0.25	-8	62	-9	23
1981	29	12	0.87	0.80	-0.28	-10	62	-8	24
1982	29	12	0.87	0.80	-0.20	-6	64	-5	25
1983	27	11	0.89	0.83	-0.01	7	68	-9	25
1984	27	11	0.89	0.82	0.03	6	63	-10	23
1985	25	10	0.90	0.85	0.03	7	61	-13	23
1986	28	11	0.91	0.85	0.06	8	73	-15	26
1987	23	10	0.92	0.85	-0.01	5	62	-3	22
1988	20	10	0.92	0.87	-0.06	0	63	-4	24
1989	21	10	0.92	0.86	-0.01	3	59	-7	24
1990	19	9	0.93	0.86	-0.04	1	61	-7	25
1991	19	9	0.93	0.87	0.06	5	63	-5	24
1992	20	10	0.93	0.87	0.10	6	66	-1	24
1993	18	9	0.94	0.88	0.13	8	70	-1	24
1994	19	9	0.94	0.88	0.21	8	71	-2	25
1995	17	9	0.95	0.88	-0.03	2	69	4	24

Table 10(b) Limited Area T+24: Verification of the Limited Area Model 24-hour forecast of the geopotential height (in metres) and geostrophic wind (in knots) at 1000 hPa, valid at 00Z.

Year	Rms Ht Error	Rms Vector Wind Error	Ht Change Corr	Stretch Vector Corr	Ht/Ht Error Corr	F/C-Actual K.E. Equiv Wind	Rms F/C Ht Chge	Mean Ht Error	Rms Actual Wind
1968	37	13	0.77	0.72	-0.43	-11	47	-14	23
1969	37	13	0.79	0.73	-0.43	-11	49	-14	23
1970	38	13	0.80	0.71	-0.36	-11	53	-16	24
1971	38	13	0.78	0.73	-0.40	-11	50	-16	22
1972	36	13	0.77	0.73	-0.41	-11	50	-10	24
1973	33	12	0.82	0.74	-0.44	-10	58	-12	23
1974	36	14	0.80	0.74	-0.43	-13	57	-2	25
1975	32	13	0.82	0.74	-0.29	-9	55	-9	23
1976	33	12	0.81	0.74	-0.38	-11	52	-4	23
1977	29	12	0.84	0.78	-0.40	-12	56	2	24
1978	28	11	0.85	0.82	-0.42	-11	54	4	24
1979	27	11	0.87	0.80	-0.40	-12	59	3	24
1980	24	10	0.88	0.82	-0.44	-12	57	0	23
1981	26	12	0.87	0.80	-0.45	-12	57	0	24
1982	26	11	0.88	0.81	-0.39	-12	61	2	25
1983	22	10	0.91	0.85	-0.16	-6	65	-3	25
1984	22	10	0.89	0.84	-0.02	3	60	-1	23
1985	20	9	0.91	0.86	-0.08	4	56	3	23
1986	22	10	0.91	0.85	-0.03	5	59	0	26
1987	19	9	0.92	0.85	-0.06	4	60	1	26
1988	20	10	0.92	0.87	-0.13	-3	61	3	24
1989	19	9	0.92	0.86	-0.06	-3	58	2	24
1990	19	9	0.95	0.86	-0.08	-3	59	2	25
1991	17	9	0.93	0.87	-0.01	0	63	0	24
1992	18	9	0.94	0.87	0.00	-1	63	0	24
1993	17	9	0.94	0.88	0.06	4	59	0	23
1994	18	9	0.94	0.89	0.10	5	59	-1	25
1995	15	8	0.95	0.89	-0.08	-1	61	4	24

Table 10(c) Global T+24: Verification of the Global Model 24-hour forecast of the geopotential height (in metres) and geostrophic wind (in knots) at 1000 hPa, valid at 00Z.

Year	Rms Ht Error	Ht Vector Wind Error	Ht Change Corr	Stretch Vector Corr	Ht/Ht Error Corr	F/C-Actual K.E. Equiv	Rms F/C Ht Chge	Mean Ht Error	Rms Actual Wind
1969	66	18	0.50	0.52	-0.49	-11	60	-35	23
1970	67	19	0.52	0.49	-0.49	-11	64	-37	24
1977	67	18	0.48	0.49	-0.48	-11	61	-36	22
1972	60	18	0.49	0.55	-0.48	-12	54	-21	24
1973	57	18	0.74	0.52	-0.50	-11	84	-20	23
1974	60	19	0.70	0.50	-0.52	-14	79	-4	25
1975	55	18	0.73	0.52	-0.41	-10	80	-17	23
1976	59	17	0.72	0.52	-0.48	-13	77	-13	23
1977	51	16	0.78	0.59	-0.49	-14	81	-13	24
1978	45	15	0.79	0.66	-0.47	-13	74	-3	24
1979	45	16	0.81	0.57	-0.44	-14	83	-4	24
1980	43	15	0.83	0.66	-0.47	-13	81	-13	23
1981	46	16	0.81	0.62	-0.50	-15	78	-12	24
1982	41	15	0.83	0.66	-0.38	-12	84	5	25
1983	34	13	0.89	0.76	-0.13	-4	90	-8	25
1984	35	14	0.86	0.74	-0.01	6	81	-5	23
1985	32	14	0.87	0.74	-0.16	4	77	0	23
1986	34	14	0.87	0.74	-0.09	6	88	-2	26
1987	32	13	0.88	0.73	-0.11	4	83	-1	22
1988	31	13	0.89	0.77	-0.15	-3	78	1	24
1989	29	13	0.87	0.76	-0.10	0	79	1	24
1990	31	13	0.87	0.76	-0.14	-4	81	3	25
1991	29	12	0.90	0.77	-0.06	2	85	-1	24
1992	29	12	0.91	0.77	-0.04	3	86	2	24
1993	27	12	0.92	0.80	0.02	3	82	-1	24
1994	31	13	0.91	0.80	0.09	9	89	-5	25
1995	25	11	0.93	0.80	-0.08	0	87	4	24

Table 10(d) Global T+48: Verification of the Global Model 48-hour forecast of the geopotential height (in metres) and geostrophic wind (in knots) at 1000 hPa, valid at 00Z.

Year	Rms Ht Error	Rms Vector Wind Error	Ht Change Corr	Stretch Vector Corr	Ht/Ht Error Corr	F/C-Actual K.E. Equiv Wind	Rms F/C Ht Chge	Mean Ht Error	Rms Actual Wind
1969	88	21	0.33	0.37	-0.55	-12	78	-50	23
1970	92	22	0.33	0.30	-0.50	-11	84	-54	24
1971	93	22	0.31	0.30	-0.57	-12	83	-53	22
1972	80	22	0.32	0.40	-0.53	-13	69	-28	24
1973	78	22	0.65	0.36	-0.54	-11	98	-23	23
1974	78	23	0.62	0.31	-0.58	-15	92	-4	25
1975	76	22	0.65	0.37	-0.47	-9	97	-21	23
1976	77	20	0.65	0.37	-0.54	-13	93	-20	23
1977	67	19	0.72	0.44	-0.58	-16	95	-22	24
1978	58	18	0.71	0.49	-0.54	-15	84	0	24
1979	61	19	0.74	0.47	-0.50	-15	95	2	24
1980	58	18	0.78	0.52	-0.53	-14	89	-10	23
1981	60	19	0.74	0.47	-0.56	-16	87	-7	24
1982	55	18	0.78	0.53	-0.42	-12	96	-3	25
1983	48	16	0.83	0.65	-0.17	3	103	-12	25
1984	48	17	0.79	0.62	-0.09	7	100	-11	23
1985	46	17	0.80	0.61	-0.22	6	89	1	23
1986	45	17	0.83	0.63	-0.20	8	97	0	26
1987	44	16	0.83	0.62	-0.21	5	95	1	22
1988	44	19	0.84	0.65	-0.26	-6	99	3	24
1989	38	16	0.83	0.59	-0.16	-2	93	2	24
1990	44	16	0.84	0.58	-0.21	-5	93	4	25
1991	43	16	0.85	0.64	-0.15	1	98	-1	24
1992	41	16	0.85	0.65	-0.14	0	96	3	24
1993	40	15	0.87	0.68	-0.07	3	95	-3	24
1994	43	16	0.87	0.69	0.03	9	101	-5	25
1995	36	15	0.88	0.68	-0.17	0	101	5	24

Table 10(e) Global T+72: Verification of the Global Model 72-hour forecast of the geopotential height (in metres) and geostrophic wind (in knots) at 1000 hPa, valid at 00Z.

TABLE 11: VERIFICATION OF LONDON PRECIPITATION FORECAST

	RAIN FORECAST	NO RAIN FORECAST	ALL CASES
1962	63	81	73
1963	71	72	72
1964	68	79	72
1965	69	76	72
1966	77	74	75
1967	73	74	75
1968	70	79	75
1969	71	78	75
1970	64	74	70
1971	63	82	76
1972	70	78	75
1973	67	80	76
1974	74	76	75
1975	68	85	77
1976	67	84	78
1977	71	79	75
1978	73	84	79
1979	72	78	75
1980	67	83	76
1981	70	87	76
1982	73	87	81
1983	73	86	80
1984	74	89	83
1985	72	85	79
1986	79	80	80
1987	78	77	78
1988	67	89	81
1989	76	84	82
1900	74	83	80
1991	69	82	77
1992	74	84	80
1993	74	90	83
1994	74	86	81
1995	75	90	84

Table 11(a) Percentage of CFO forecasts correct.

1984	58	86	74
1985	77	76	77
1986	78	73	75
1987	78	61	70
1988	**	**	**
1989	74	82	80
1990	73	81	79
1991	67	79	75
1992	65	82	74
1993	65	91	78
1994	65	89	75
1995	71	93	83

Table 11(b) Percentage of Limited Area Model forecasts correct

TABLE 12: VERIFICATION OF THE BBC FORECAST FOR THE WHOLE UK

	FORECAST FOR TODAY (0755)					FORECAST FOR TOMORROW (1755)				
	WIND	WX	SKY	TMAX	ALL	WIND	WX	SKY	TMAX	ALL
Southeast	83	88	90	88	87	84	83	82	84	83
Midlands	97	92	92	94	94	95	88	88	92	91
East Anglia	83	86	89	88	87	80	82	83	86	83
Southwest	94	87	89	87	89	90	83	85	86	86
West & South	95	91	91	89	91	93	89	88	87	89
Wales	88	92	95	89	91	88	88	92	89	89
North	85	90	90	92	90	81	84	86	90	86
Northeast	95	83	87	84	87	91	79	81	82	83
N Ireland	84	85	88	93	88	87	82	84	93	86
Scotland	79	84	87	87	85	79	81	85	86	83

Table 12(a) Results for each region of the UK (for the period January 1995 to December 1995) expressed as a percentage of the total possible score for forecast wind, weather (WX), sky, and maximum temperature (TMAX): also the overall result.

	FORECAST FOR TODAY (0755)					FORECAST FOR TOMORROW (1755)				
	WIND	WX	SKY	TMAX	ALL	WIND	WX	SKY	TMAX	ALL
72/3-79/80	85	83	87	87	86	76	76	80	83	79
1980/81	84	84	87	88	86	77	77	81	83	80
1981/82	83	84	88	88	86	78	78	82	84	81
1982/83	84	83	88	88	86	78	77	82	83	80
1983/84	87	86	88	88	87	83	82	84	84	83
1984/85	84	83	88	88	86	80	77	82	83	81
1985/86	84	84	88	88	86	81	78	84	84	82
1986/87	85	86	89	88	87	81	81	85	83	83
1987/88	86	85	89	88	87	82	81	85	85	83
1988/89	86	87	90	90	88	82	83	85	87	84
1989/90	**	88	90	88	88†	**	84	85	84	84†
1990/91	84	86	89	89	87	84	82	85	86	84
1991	84	86	89	89	87	83	83	85	86	84
1992	87	86	89	89	88	84	82	86	87	85
1993	90	88	90	89	89	87	84	87	85	86
1994	88	87	89	89	88	86	82	85	87	85
1995	86	87	89	89	88	85	83	85	87	85

Table 12(b) Results averaged over all regions of the UK, expressed as a percentage of the total possible score for forecast wind, weather (WX), sky, and maximum temperatures (TMAX): also the overall result. (Prior to 1991, annual results were calculated over the 12 months from August to July).

†N.B.: Because of a change in the BBC's requirements for wind forecasts, results for wind verification were not produced for 1989/90. The overall result for 1989/90 is the average over three elements (WX, SKY and TMAX) only.

TABLE 13: ANNUAL MEAN STATISTICS FOR THE GLOBAL WAVE-MODEL

VERIFICATION AGAINST OBSERVATIONS

	MEAN ERROR			RMS ERROR		
	T+24	T+48	T+72	T+24	T+48	T+72
1988	1.2	1.2	1.2	6.0	7.0	7.8
1989	1.2	1.2	1.2	5.8	7.0	7.8
1990	0.8	1.0	0.8	5.6	6.6	7.2
1991	1.0	1.2	1.4	5.2	6.2	7.2
1992	0.4	0.8	1.0	5.1	6.0	6.8
1993	0.8	1.0	1.2	5.1	5.8	6.8
1994	0.8	1.4	1.4	5.1	6.0	6.8
1995	1.0	1.2	1.2	5.1	6.0	6.8

Table 13(a) Mean and RMS errors of wind speed forecasts used as input for the Global Wave Model (in knots).

	MEAN ERROR			RMS ERROR		
	T+24	T+48	T+72	T+24	T+48	T+72
1988	0.1	0.1	0.0	0.9	1.0	1.1
1989	-0.1	0.0	0.0	0.9	1.0	1.1
1990	-0.1	-0.1	-1.0	0.8	0.9	1.1
1991	-0.3	-0.2	-0.2	0.9	0.9	1.0
1992	-0.4	-0.4	-0.4	1.0	1.1	1.2
1993	-0.2	-0.2	-0.2	0.8	0.9	1.0
1994	-0.3	-0.2	-0.1	0.8	0.9	1.0
1995	-0.1	0.0	0.0	0.7	0.8	0.9

Table 13(b) Mean and RMS errors of wave height forecasts from the Global Wave Model (in metres).

	MEAN ERROR			RMS ERROR		
	T+24	T+48	T+72	T+24	T+48	T+72
1988	-0.7	-0.6	-0.7	2.4	2.6	2.8
1989	-0.3	-0.1	-0.1	2.5	2.7	2.9
1990	-0.1	0.0	0.1	2.4	2.6	2.7
1991	***	***	***	***	***	***
1992	-0.2	-0.3	-0.4	3.3	3.9	4.0
1993	0.3	0.1	0.0	2.6	2.7	2.8
1994	0.3	0.1	0.1	2.6	2.7	2.8
1995	0.6	0.5	0.5	2.5	2.7	2.8

Table 13(c) Mean and RMS errors of wave period forecasts from the Global Wave Model (in seconds).

TABLE 14: ANNUAL MEAN STATISTICS FOR THE EUROPEAN WAVE-MODEL

VERIFICATION AGAINST OBSERVATIONS

	MEAN ERROR			RMS ERROR		
	T+12	T+24	T+36	T+12	T+24	T+36
1988	0.8	1.0	1.0	5.2	6.0	7.0
1989	1.0	1.2	1.4	5.2	5.8	6.8
1990	1.2	1.2	1.4	5.2	5.8	6.4
1991	0.8	1.2	1.6	4.9	5.4	6.2
1992	0.8	1.4	1.6	5.2	6.0	6.8
1993	0.7	1.2	1.4	5.1	5.8	6.6
1994	1.4	1.6	2.1	5.1	5.8	6.6
1995	1.4	1.5	1.9	4.7	5.4	6.0

Table 14(a) Mean and RMS errors of wind speed forecasts used as input for the European Wave Model (in knots).

	MEAN ERROR			RMS ERROR		
	T+12	T+24	T+36	T+12	T+24	T+36
1988	0.1	0.1	0.1	0.8	0.9	0.9
1989	0.2	0.2	0.3	0.9	0.9	1.0
1990	0.0	0.0	0.0	0.9	0.9	1.0
1991	0.1	0.1	0.1	1.0	1.0	1.1
1992	-0.2	-0.1	0.0	0.9	0.9	1.0
1993	-0.2	-0.2	-0.1	0.9	0.9	1.0
1994	-0.2	-0.1	0.0	0.8	0.8	0.9
1995	0.0	0.0	0.1	0.7	0.8	0.8

Table 14(b) Mean and RMS errors of wave height forecasts from the European Wave Model (in metres).

	MEAN ERROR			RMS ERROR		
	T+12	T+24	T+36	T+12	T+24	T+36
1988	-0.3	-0.3	-0.3	1.5	1.6	1.6
1989	-0.1	0.0	0.0	1.6	1.6	1.7
1990	-0.2	-0.2	-0.2	1.3	1.3	1.4
1991	-0.3	-0.3	-0.2	1.6	1.6	1.6
1992	-0.4	-0.3	-0.2	1.9	1.9	1.9
1993	-0.4	-0.3	-0.3	1.9	1.9	2.0
1994	0.0	0.0	0.0	1.1	1.4	1.5
1995	-0.6	-0.5	-0.5	1.6	2.0	2.0

Table 14(c) Mean and RMS errors of wave period forecasts from the European Wave Model (in seconds).

FIGURE 3. VERIFICATION AGAINST OBSERVATIONS - AREA 2

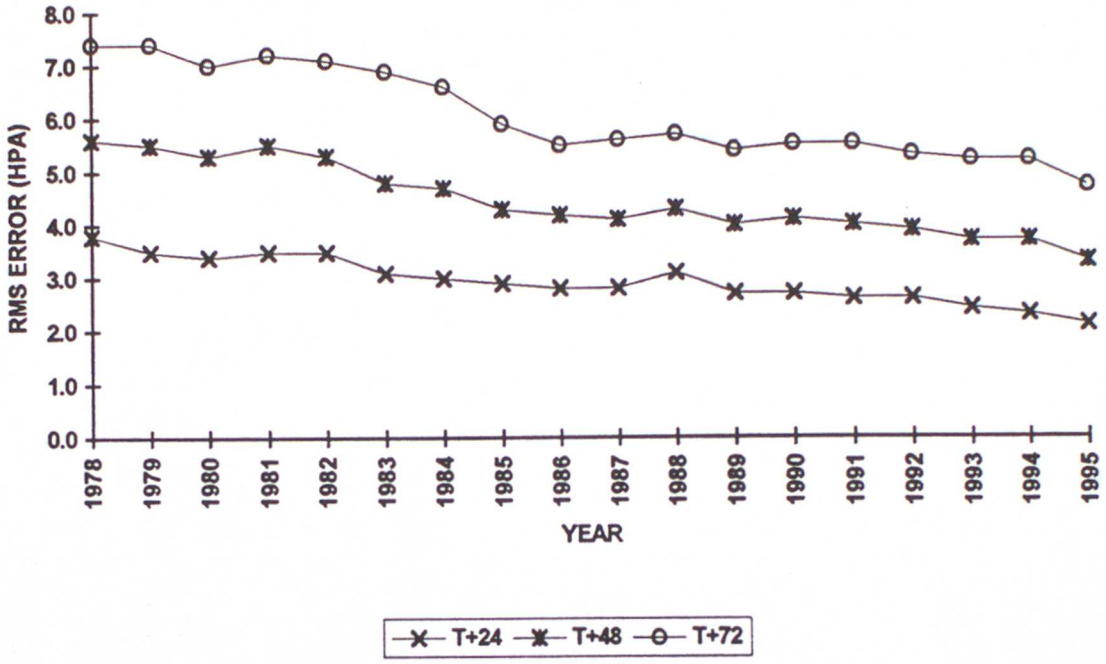

Figure 3(a) Rms error of PMSL

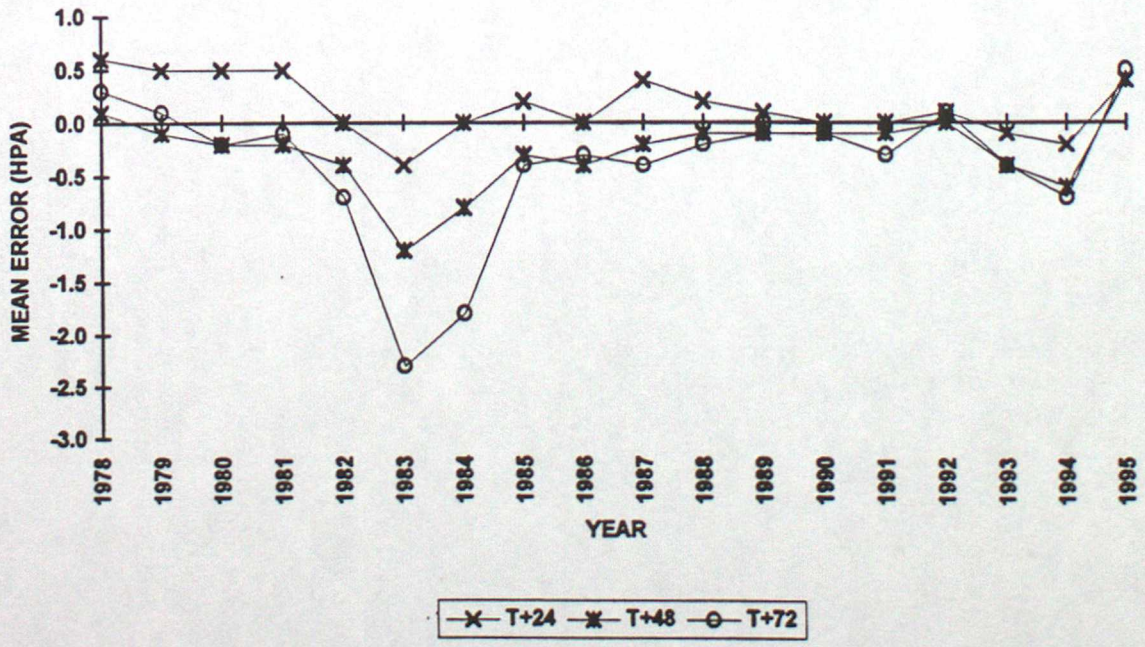

Figure 3(b) Mean error of PMSL

FIGURE 4. VERIFICATION AGAINST ANALYSES - AREA 2

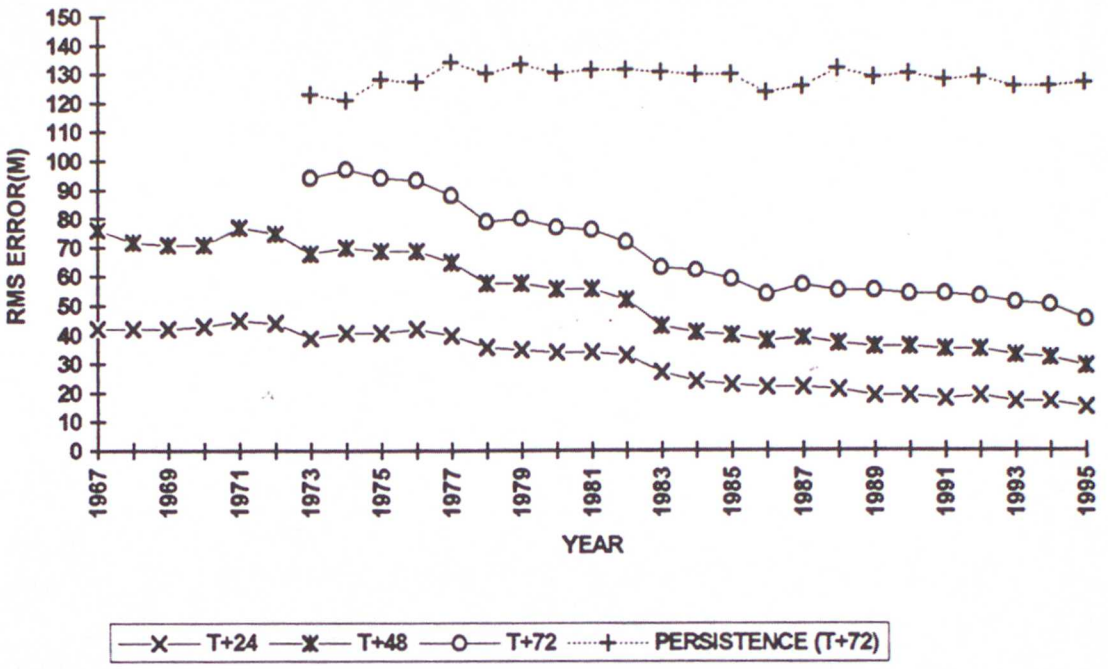

Figure 4(a) Rms error of 500 hPa height

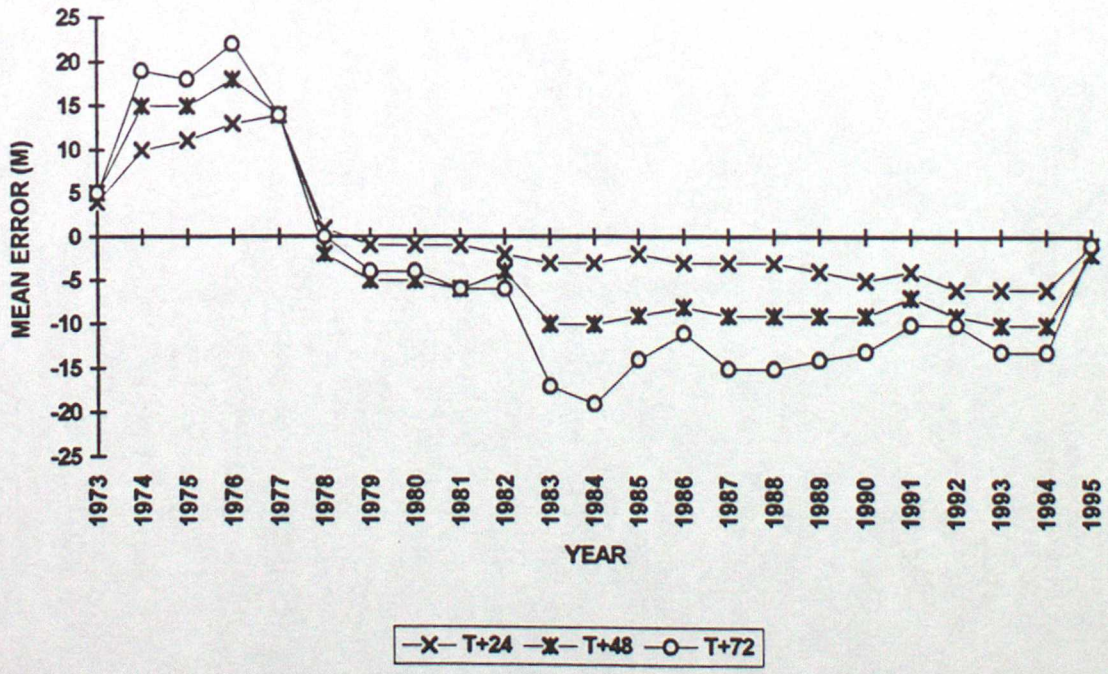

Figure 4(b) Mean error of 500 hPa height

FIGURE 5. VERIFICATION AGAINST ANALYSES - AREA 2

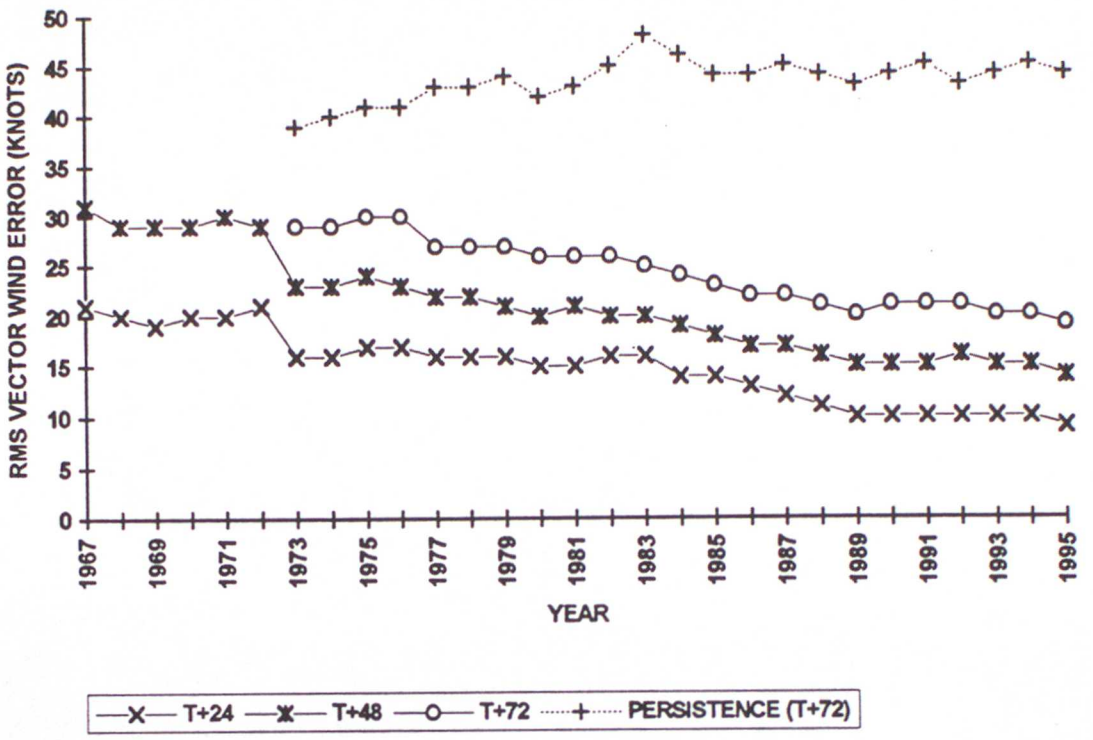

Figure 5(a) Rms vector wind error at 200 hPa

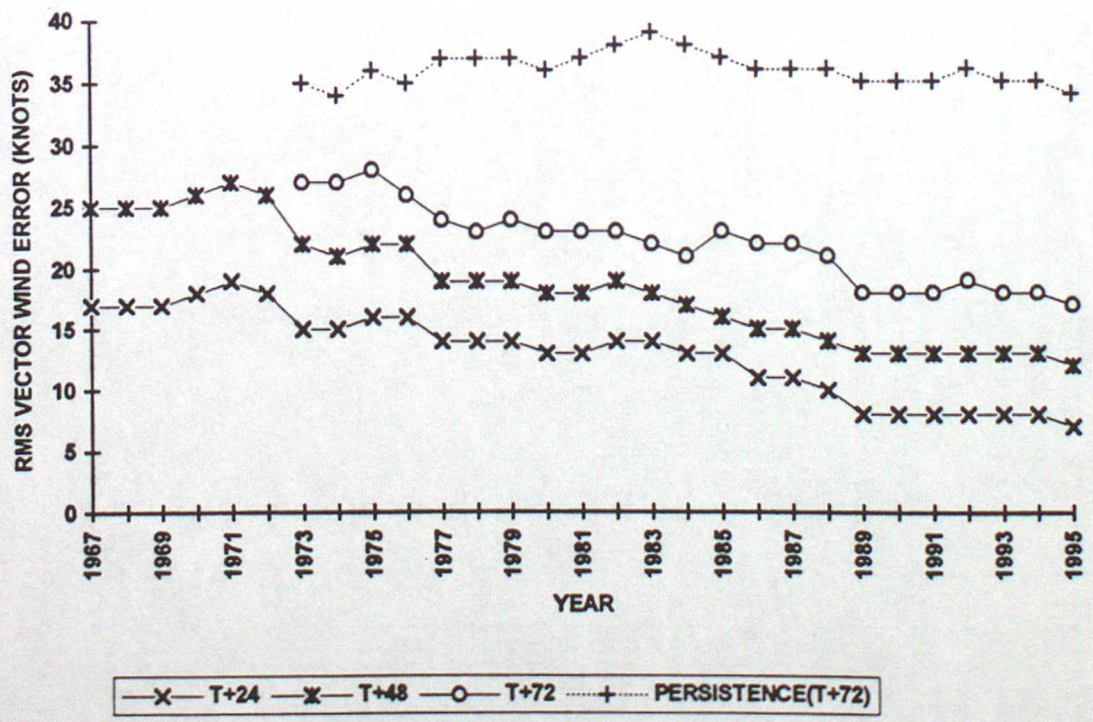

Figure 5(b) Rms vector wind error at 500 hPa

FIGURE 6. VERIFICATION AGAINST ANALYSES - NORTHERN HEMISPHERE

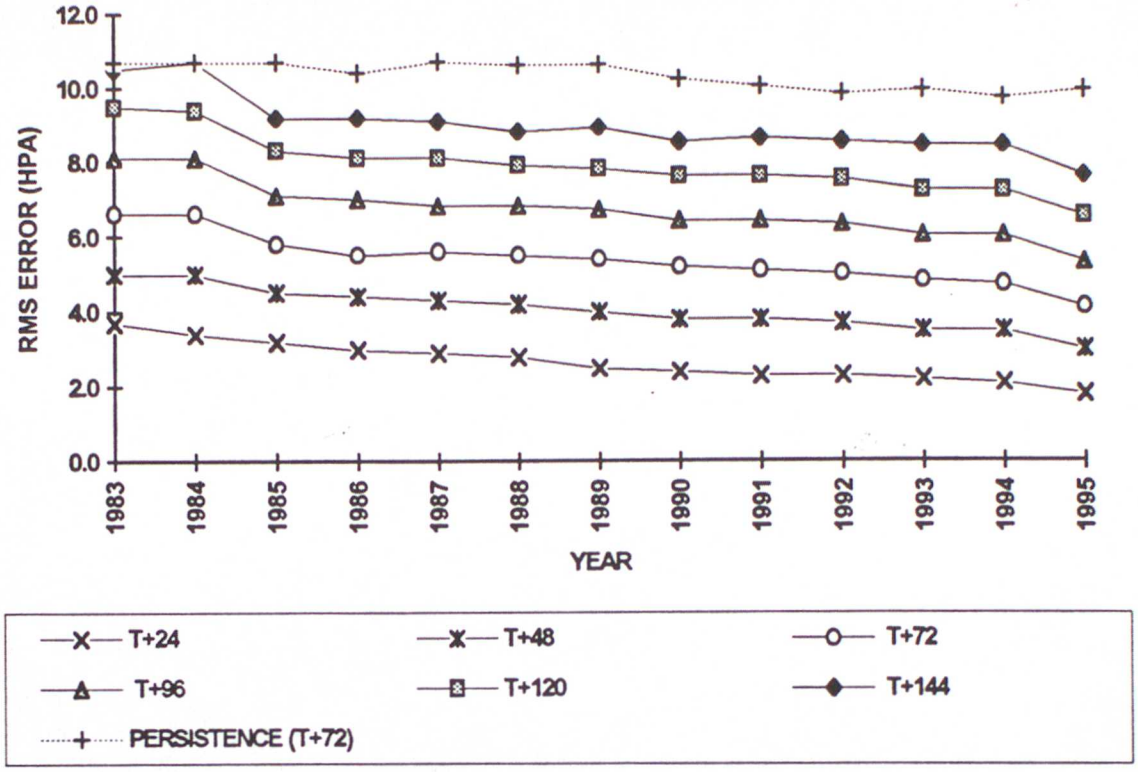

Figure 6(a) Rms error of PMSL

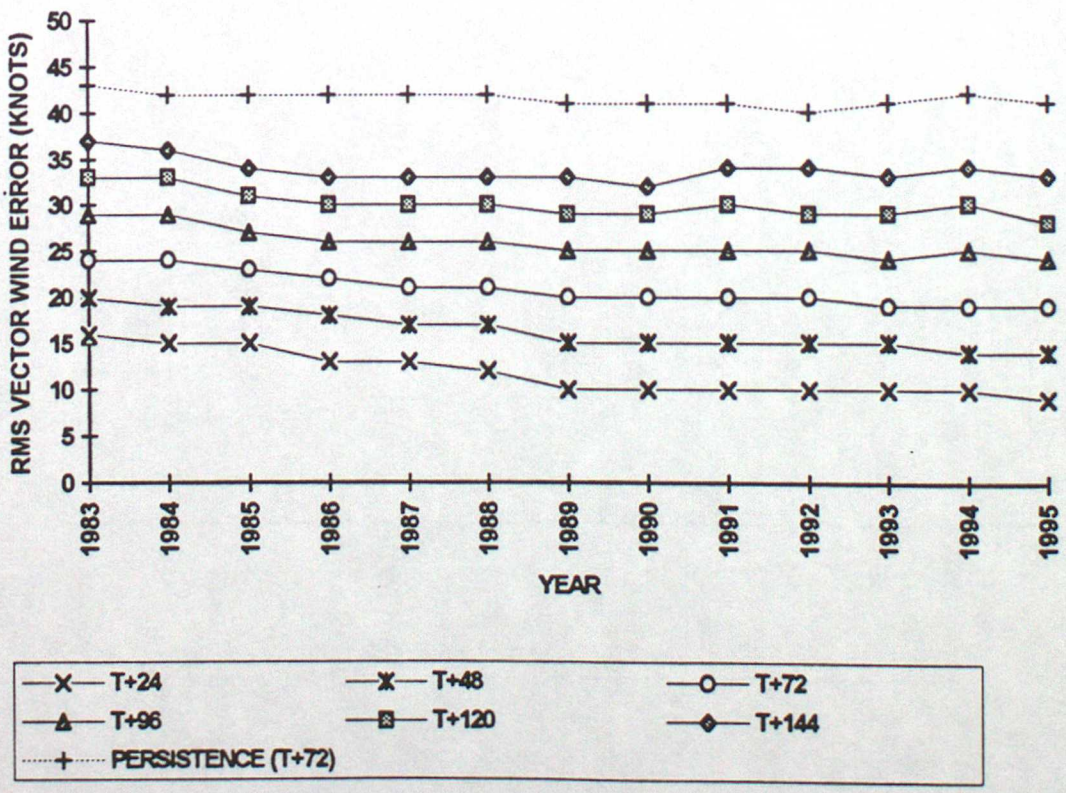

Figure 6(b) Rms vector wind error at 200 hPa

FIGURE 7. VERIFICATION AGAINST ANALYSES - TROPICS

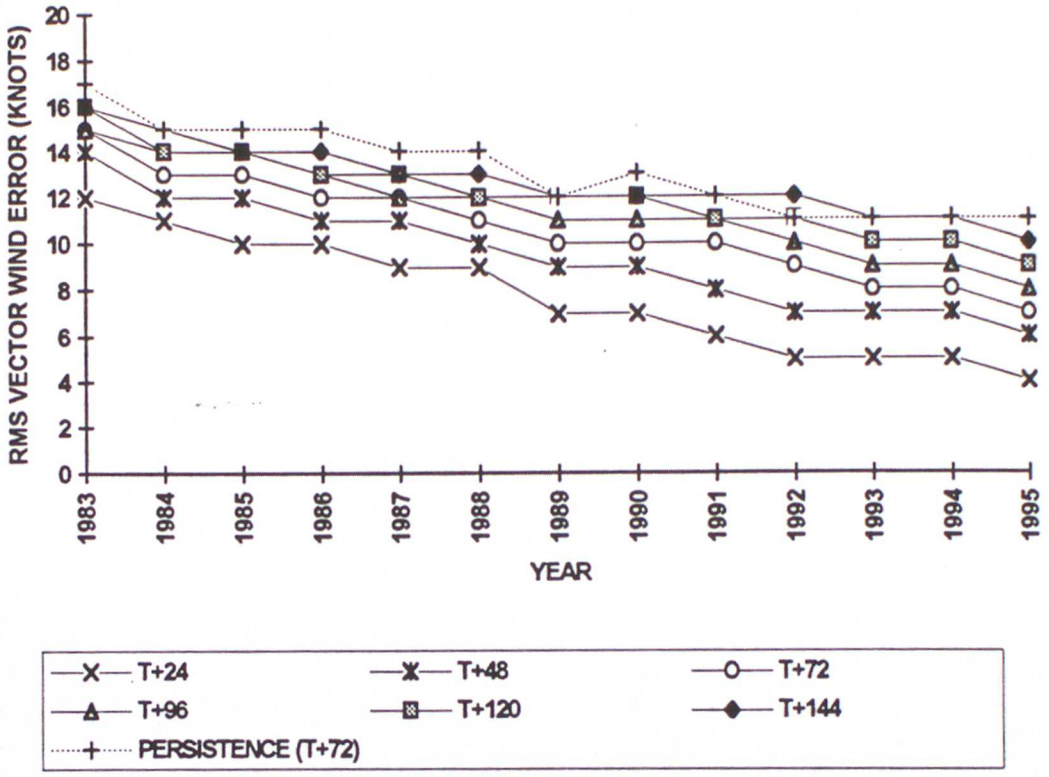

Figure 7(a) Rms vector wind error at 850 hPa

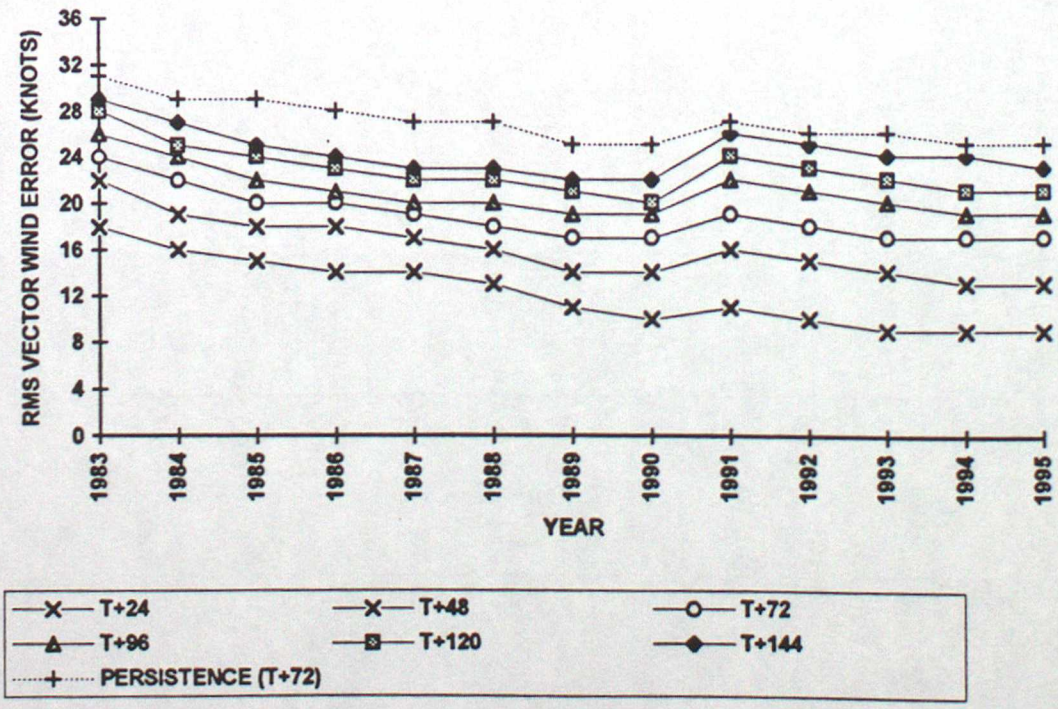

Figure 7(b) Rms vector wind error at 200 hPa

FIGURE 8. VERIFICATION AGAINST ANALYSES - SOUTHERN HEMISPHERE

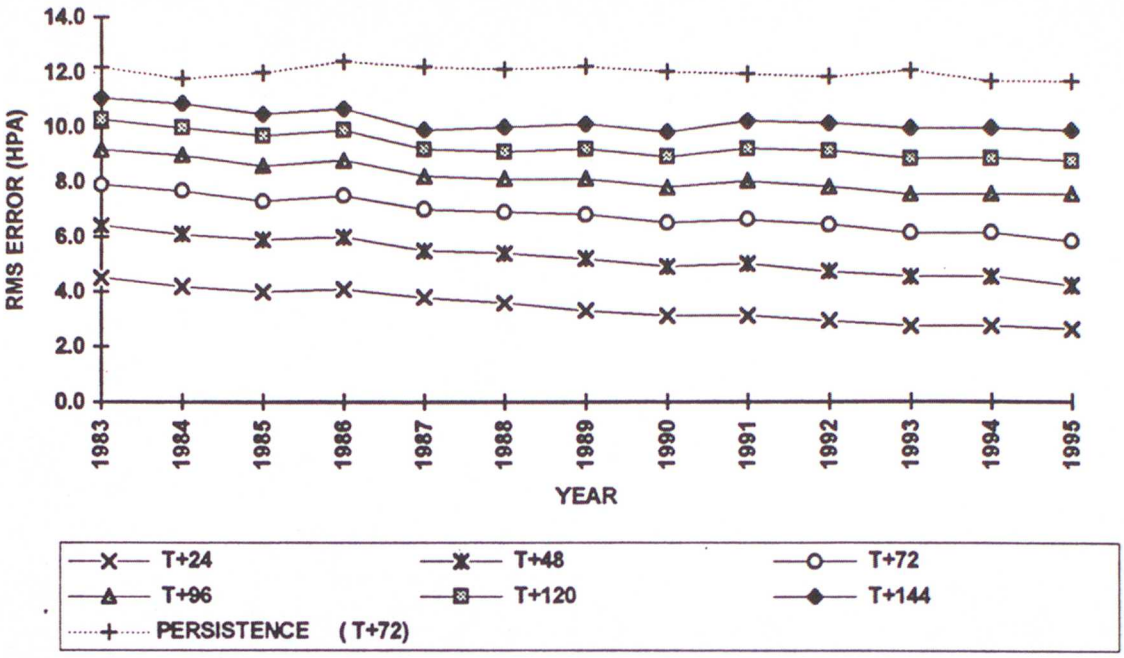

Figure 8(a) Rms error of PMSL

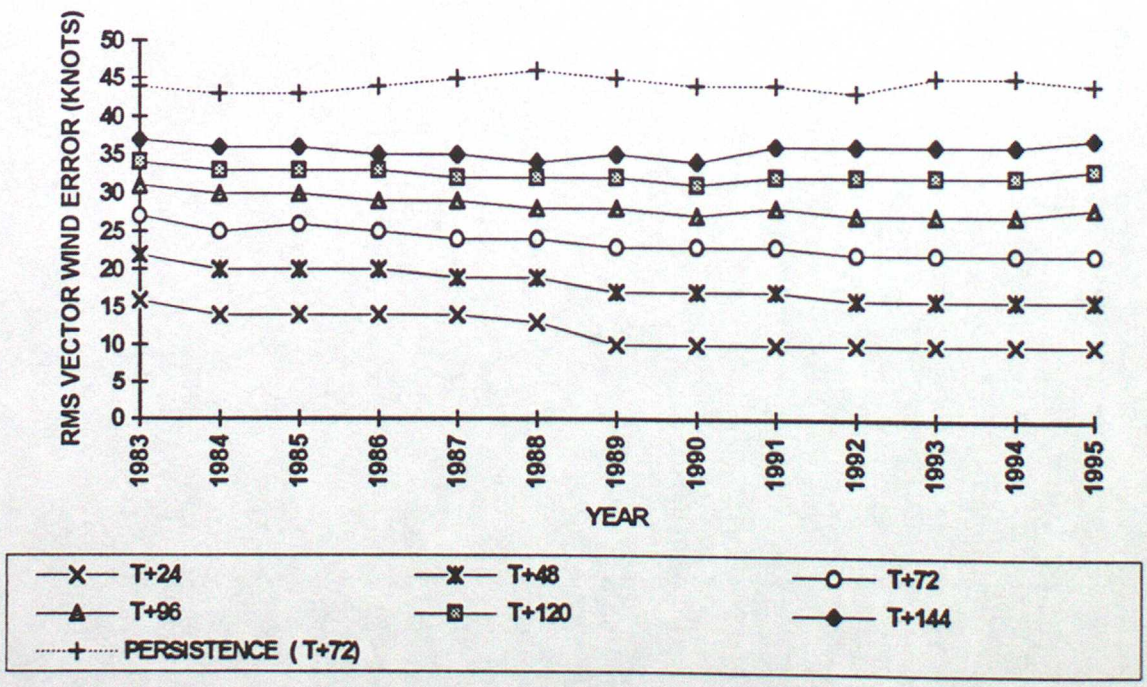

Figure 8(b) Rms vector wind error at 200 hPa

FIGURE 9. 48-POINT VERIFICATION SCHEME

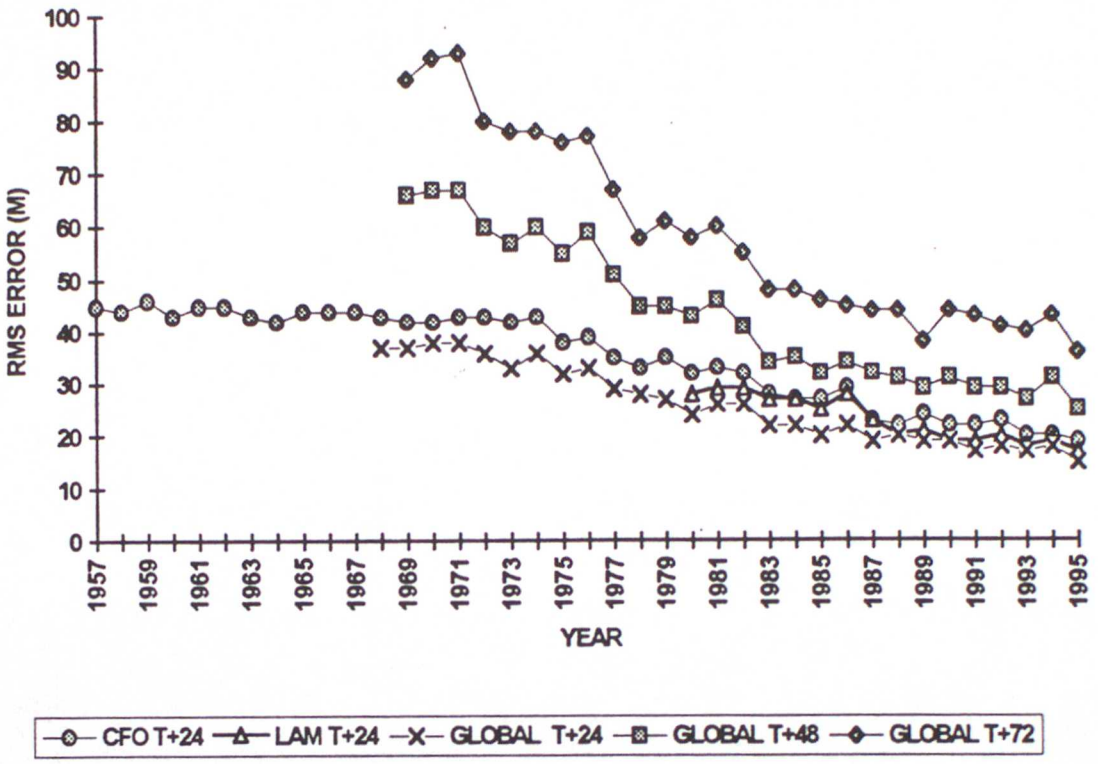

Figure 9(a) Rms error of 1000 hPa height

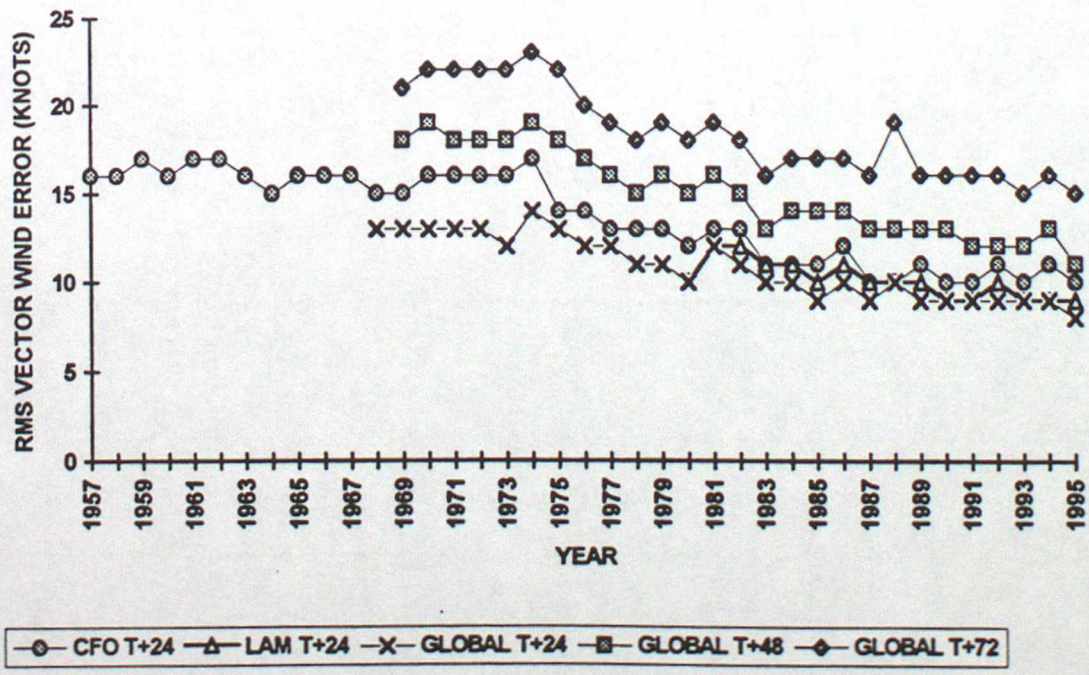

Figure 9(b) Rms vector wind error at 1000 hPa

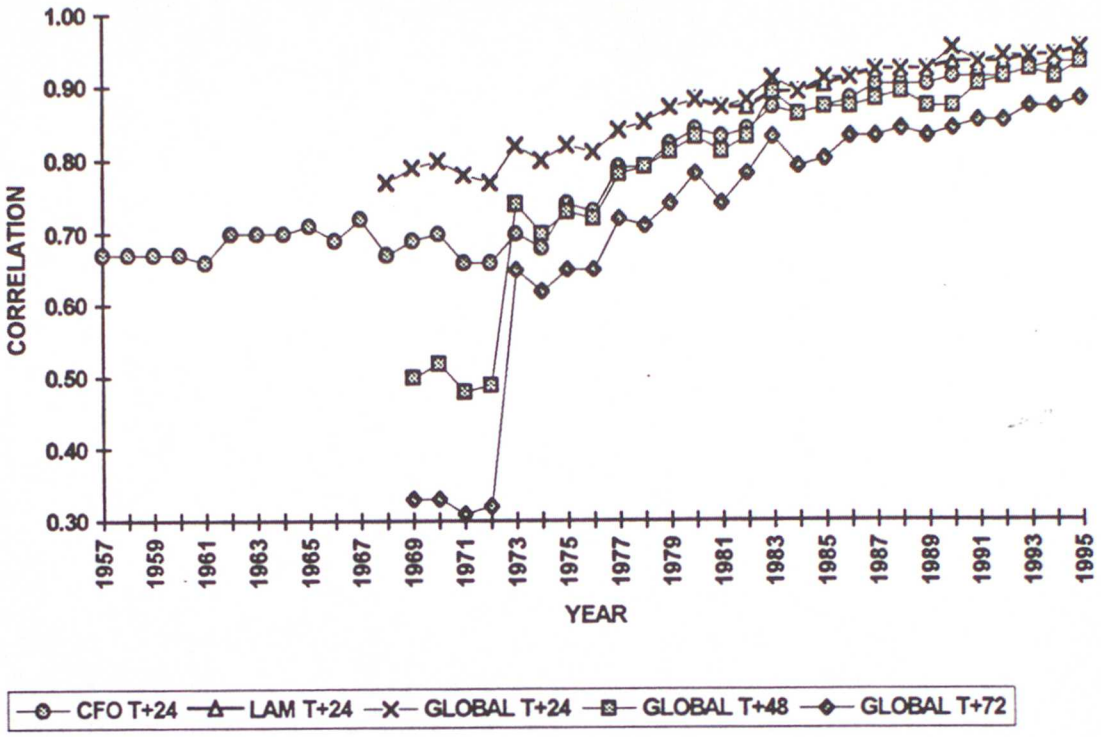

Figure 9(c) Height change correlation at 1000 hPa

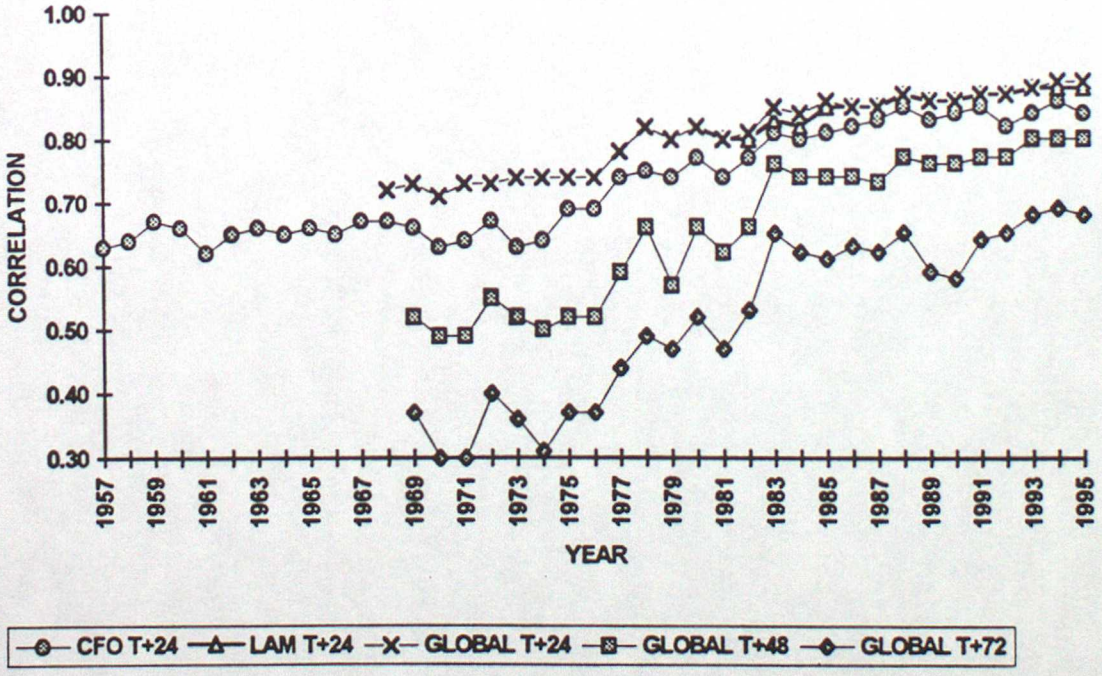

Figure 9(d) Wind stretch vector correlation at 1000 hPa